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THE ECONOMIC IMPLICATIONS OF RECENT TECHNICAL DEVELOPMENTS IN THE PROCESSING OF TURKEYS

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THE ECONOMIC IMPLICATIONS OF RECENT TECHNICAL DEVELOPMENTS IN THE PROCESSING OF TURKEYS[1]

by

John C. Abbott[2]

Introduction and Setting

A new set of poultry-marketing procedures has developed during the recent postwar years.[3] Formerly, much of the final processing and preparation of meat poultry was handled primarily by specialized butchers and retail dealers. Poultry processing plants mainly turned out dressed birds, plucked, and bled but with head, feet, and entrails still intact. Preparation for the oven was carried out only as a consumer service after the bird had been sold on the dressed-weight basis.

In contrast, more chickens and turkeys are sold now on a ready-to-cook basis through the self-service food markets where most other household requirements may be obtained at the same time. Adaptation to self-service methods presupposes a minimum of skilled attention at the time of sale and presentation to the consumer in an appealing and sanitary form. Evisceration and individual packaging in transparent plastic bags at the processing point enable poultry meat to satisfy these requirements.

The use of hot water to loosen feathers for easier removal replaced dry picking in commercial dressing operations many years ago. However, semiscalding (placing birds in water at temperatures up to 130° F.) still left considerable handwork for completion after birds had passed through the mechanical pickers. Scalding at 160-180° F. damaged the skin, detracting from both the appearance of the carcass and its keeping qualities. The advantages of using intermediate temperatures (138-140° F., subscalding) lie in the possibility of

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[1] This study has been made possible by the cooperation of leading commercial and farm turkey processors in the state of California.

[2] Instructor in Agricultural Economics, Junior Agricultural Economist in the Experiment Station and on the Giannini Foundation, Davis, California. Resigned July 31, 1954.

[3] Compare G. F. Stewart, "The Turkey Marketing Revolution," California Turkey News, San Francisco, September, 1952, p. 29.

dispensing with the bulk of the supplementary hand-picking and finishing labor and still presenting to the public a product free of pinfeathers.[1] Additional advantages are that turkeys may be marketed at an earlier age without the same likelihood of grade penalization because of pinfeathers.

In the past, subscalding was not adopted generally for fear of sales resistance to the product. The cuticle or outer layer of skin is completely removed. On exposure to the air, the underlying skin darkens quickly and turns brown. The initial white finish may be retained only so long as the carcass is protected from dehydration by moisture or by being placed in a moisture-vapor-proof wrap. Subscalding remained impracticable until a suitable plastic covering came onto the market at a reasonable price. Durable transparent wraps that shrink to fit the carcass and withstand the passage of moisture vapor are now available. Quick freezing of subscalded produce so enclosed results in a neat bright finish of great appeal. The trend toward subscalding has received great impetus in consequence.

Objectives

The research project upon which this paper is based was designed to furnish information on problems raised by these innovations in processing technique and marketing. Operators of existing or proposed plants are interested in the implications of these alternative procedures with regard to desirable capacity levels, duration of operating season, the investment involved, and the potential saving in costs. The objective of this study is to determine the most efficient combinations of labor and equipment under different conditions of plant scale, technical procedure, and season length.

Importance of the Industry

While the conclusions are based on data derived from California plants, they should be meaningful for turkey processors in all parts of the country. Physical relationships have been emphasized wherever possible so that price differences between places and time periods should not obscure this significance. During the years 1951-1953, the annual gross farm income in California

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[1] Pool, M. F., F. P. Mecchi, Hans Lineweaver, and A. A. Klose, "Effect of Scalding Temperature on the Processing and Initial Appearance of Turkeys." (Paper presented to the 42nd Annual Meeting of the Poultry Science Association, Vancouver, British Columbia, August, 1953.)

from the sale of turkeys for meat amounted to some $60,000,000. This sum is approximately equivalent to that derived from sales of meat chicken and half that coming from eggs; it comprises 2.5 per cent of the value of all agricultural commodities marketed in this state.

Table 1 indicates the pace of the expansion since the prewar period. In California, as in the country as a whole, the production of turkeys has doubled since 1946. Currently, one sixth of the total United States supply is raised in this state. Its output is double that of Minnesota, the next largest.

TABLE 1

Turkey Production and Receipts for California
Averages 1938-1941, 1946-1949, 1951, 1952, and 1953

Year	Turkeys marketed	Average live weight	Average price	Total receipts
	millions	pounds	cents per pound live weight	million dollars
Average				
1938-1941	2.98	16.8	17.6	8.8
1946-1949	5.35	20.6	37.0	40.1
1951	9.05	19.2	36.7	63.8
1952	11.24	18.7	31.0	65.2
1953	9.97	19.3	31.1	59.9

Concentration on developing the heavy Broad Breasted Bronze turkey through the war decade brought a steady increase in the average size of bird marketed in the western states. Subsequently, recognition of the needs of smaller families led to experiments with Beltsville Small Whites and other breeds maturing at lighter weights. Young Bronze turkeys have been marketed at 12-14 weeks as fryer-roasters. The lower average weight of bird in 1952, when light-breed turkeys made up 18.5 per cent of the total crop, marks the current peak in this movement. Sales of lightweight turkeys fell in 1953 in response to a sharp price reaction. A stable production pattern for the smaller bird has not yet been established.

A high level of employment and consumer income combined with restricted marketings of beef in the years following the war provided an exceptionally favorable environment for an increase in the consumption of turkey meat. The average United States annual per-capita consumption of 1951-1953 exceeded 4

pounds eviscerated weight as compared with 2.1 pounds in 1935-1939.[1] These gains in the consumption of turkey meat have been maintained very largely through fluctuations in the consumption of other meats far exceeding the quantity of turkey meat affected. Thus, there are grounds for the view that the general public has accepted a substantially higher level of turkey meat consumption as normal. The long-term trend toward a higher protein diet is in its favor. Popular aversion to the solid fat associated with many red meat cuts may extend the proportion of proteins derived from poultry.

Increasing Competitive Pressure

Lower prices since 1950 have raised doubts as to whether the turkey industry can be maintained on its present expanded scale in California. Table 2 indicates the extent to which local production may exceed local consumption and the consequent effect on regional price relationships.[2] If the average rate of consumption for the United States prevailed in California in 1953, its production was more than double the quantity needed to satisfy home requirements. Per-capita consumption in California may, however, be higher than in the country as a whole in reflection of lower prices relative to incomes (Table 2) and intensive trade promotional activity.[3] Restaurants and institutional caterers have found the large tom turkey a convenient item on a regular menu. Great efforts have been made to develop new markets for "fryer-roasters," cut-up parts, and semiprocessed steaks and rolls. Various studies have explored the potentialities of a broader turkey market in which turkey products become part of the average person's everyday diet.[4] Net gains are achieved, however, only

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[1] U. S. Agricultural Marketing Service, The National Food Situation (Washington: Govt. Print. Off., February, 1954), p. 4.

[2] One major enterprise disposed of its turkeys from the record 1952 crop year as follows: California buyers, 49 per cent; eastern markets, 28 per cent; armed forces, 16 per cent; and school lunch program, 7 per cent. A prominent distributor estimates that 60 per cent of the crop was shipped out of California to eastern and military buyers.

[3] The California Turkey Promotion Advisory Board was set up in 1952 with power, under a state marketing order, to collect assessments from all growers.

[4] Ellsworth, H. M., Problems and Possibilities of Expanding the Sale and Consumption of Turkeys in California (Sacramento: Calif. State Print. Off., 1951). (State Bureau of Markets.)
Fischer, C. M. and D. B. DeLoach, Consumer Response to the Marketing of Cut-Up Turkey (Corvallis: 1948), 32p. (Oregon Agricultural Experiment Station Bul. 457.)

so long as the major Thanksgiving and Christmas holiday markets remain unaffected. Undue consumer familiarity with a turkey diet might ultimately sap the strength of the traditional demand for "family occasions."

TABLE 2

Turkey Production and Population Ratios,
United States, by Regions, 1953

Area	Production per capita	Ratio regional production per capita to United States average	Average farm price
	pounds live weight	per cent	cents per pound live weight
North Atlantic	1.8	30	40.5
East North Central	3.6	60	35.5
West North Central	14.3	260	33.1
South Atlantic	6.1	103	35.6
South Central	3.2	53	31.2
West	14.3	238	31.2
California	15.9	265	31.1

Sources:

U. S. Bureau of Agricultural Economics, Farm Production Disposition, Cash Receipts and Gross Income: Turkeys, 1952-53 (Washington: Govt. Print. Off., March, 1954), p. 3.

U. S. Bureau of the Census, Current Population Reports: Population Estimates (Washington: Govt. Print. Off., December, 1953), p. 3. (Adjusted to latest 1953 estimate.)

Since the possibility of local consumers taking up the whole supply of California turkeys is remote for the immediate future, the continuance of the industry at its present level of output depends on its ability to sell turkeys profitably in other parts of the country. Turkeys are produced in excess of local demand throughout the West and Midwest, therefore, the disposal of California surpluses depends primarily on shipments to the East Coast. The extent to which California birds share in this market depends on their ability to compete successfully in price and quality.

On the New York market, far western turkeys have built up substantial prestige. A high proportion falls into the top quality categories as a result of consistent grading and inspection before dispatch. Regularly, California birds are quoted at the highest prices, yet, net returns to the shipper are reduced by icing and rail charges considerably in excess of those borne by birds

originating in major competing areas.[1] It is doubtful whether lower production costs compensate adequately for these adverse freight differentials. The natural advantages enjoyed by California growers are probably limited to its mild winter and dry summer with attendant savings on housing and mortality losses.[2] In the past, disease losses in growing birds have been substantially lower than in most other turkey areas.[3] But this advantage is fast disappearing as competing producers raise their performance to approach California standards. Since more grain and feed ingredients, the growers' main cost factor, are required in California than are produced locally, part of the feed used also bears transportation charges.

Significant, therefore, is the tendency for areas situated closer to the East Coast cities to claim a higher proportion of those markets. Sales to the armed services for delivery at other than West Coast points may also recede. In the face of threatened overproduction, output in California was cut down in 1953, while that of Minnesota and the West North Central region continued to expand. Thus, it is evident that maintenance of the California industry's position will hinge almost entirely upon superior efficiency in all phases of production and marketing.

Opportuneness of Research

The advent of radical new technological procedures in an increasingly competitive environment makes appreciate of their advantages and implications critically important. Most processors recognize the need to keep up their plants to modern standards. Some may suspect that the revolution is not complete and hesitate to adopt current new procedures for fear the investment will

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1/ Net cost per pound to New York from San Francisco was estimated at 3.87 cents; from Fort Worth, 2.92 cents; from Minneapolis, 2.01 cents; and from Richmond, Virginia, 1.01 cents as of December, 1951. Fischer, C. M., Studies in Turkey Marketing in the Western States (Logan: May, 1952), p. 12. (Utah Agricultural Experiment Station Special Report No. 6.)

2/ Asmundsen, V. S. and F. H. Kratzer, Turkey Production in California (Berkeley: 1951), 60p. (California Agricultural Extension Service Circ. 110 revised.)

3/ U. S. Bureau of Agricultural Economics, Farm Production, Disposition, Cash Receipts and Gross Income: Turkeys, 1952-53 (Washington: Govt. Print. Off., March, 1954), p. 6 and California State Department of Agriculture, Poultry and Hatchery Production in California (Sacramento: 1953), p. 7. (The difference in mortality losses between California and, for example, Texas amounted to a differential in production costs of as least 1.0 cent per pound live weight in the years 1946-1950. This margin no longer obtains.)

prevent their adopting still more advantageous techniques that may be developed subsequently. Whichever view predominates, an economic evaluation of the changes now under way and their effects on over-all costs will aid in planning for the future. This study sets out relationships and develops information designed to help the industry in answering such questions.

Plants and Procedures

Three stages stand out in the development of commercial poultry processing methods: semiscald New York dressing with evisceration in the retail store, semiscald dressing with evisceration in the same plant, and subscald dressing with evisceration in the same plant.

Many phases of these alternative procedures are interdependent. Particular decisions at one stage may limit subsequent freedom of choice in technique. Likewise, adoption of a final form for presentation to the consumer may render certain earlier procedures obligatory under the current conditions of technological and marketing practice.

Alternative Procedures

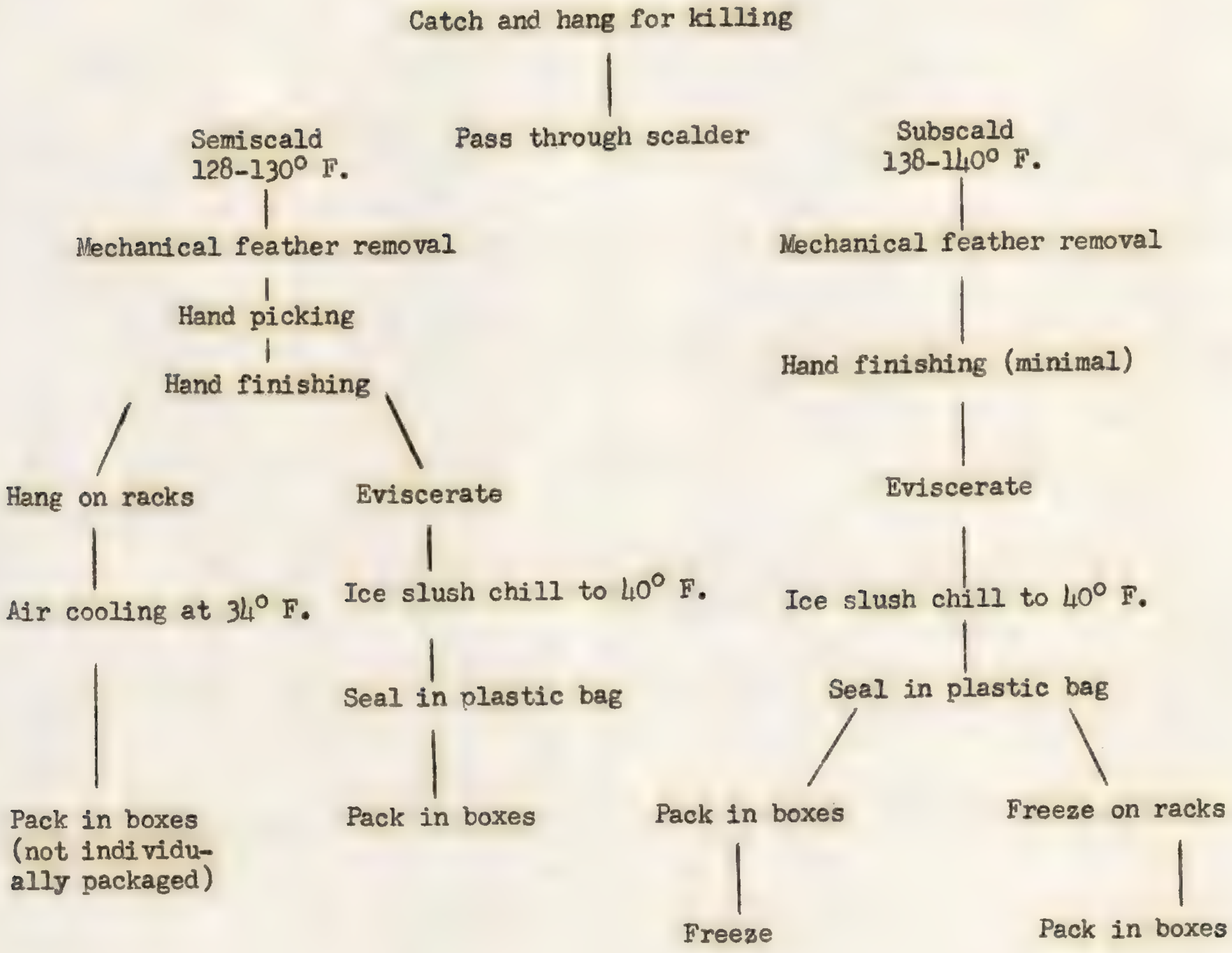
The different steps in these alternative processing sequences are set out in Figure 1. In all cases, the live birds are moved from the farm to the processing point by motor truck equipped with a detachable body made up of wooden coops in tiers. At the processing plant they are conveyed directly from the truck to the killing point and thence to a scalding tank. Most of the feathers are removed by contact with mechanical pickers of the revolving rubber finger type and the remainder by hand.

Under the older New York system, evisceration is delayed until the bird has been purchased by the ultimate consumer. The dressed carcass, complete with head, feet, and entrails, is hung on racks. These are wheeled into 34° F. refrigeration compartments to cool overnight, then, moved out to the packers. An integral part of the plant, this cooling room is located between dressing and packing areas with a space on one side for the return passage of the racks. Packing is limited to wrapping the head in paper and placing the carcasses in wooden boxes with wax paper linings. Most New York dressed poultry is marketed fresh. Freezing might be resorted to ultimately as an alternative to spoilage. Customarily, evisceration is carried out as a consumer service by the retailer. Subscalding is not used on birds distributed New York dressed style since they cannot be protected from contact with the air. Clothing the carcass with a plastic cover is impracticable when head and feet remain attached.

Under both the other systems, evisceration is completed in the processing plant. Head, feet, and viscera are removed on the line. The carcass is trimmed, washed, and immersed in ice slush to cool. When the body heat has been removed, the carcass is allowed to drain. Edible viscera are cleaned and replaced in the

FIGURE 1

Alternative Turkey Processing Procedures



body cavity. The whole carcass is then sealed in a plastic film covering, packed in a box or carton, and moved away either for immediate sale or freezing.

The critical difference between the semiscald and subscald evisceration plants lies in the picking labor requirements. Semiscald plants require a large hand-picking crew and additional pinners together with a longer conveyor line with more space to accommodate the pickers. Some also use hand-operated drum pickers.

In evisceration and packaging, the same practices are pursued in both types of plants. Deterioration of the appearance of the product through dehydration presents less serious problems in semiscald operations. However, ice slush chilling is employed as much, perhaps, to avoid the shrinkage loss associated with dry cooling as to effect the necessary reduction in the temperature of the carcass. All such plants clothe the eviscerated turkey in a plastic bag.

Final packing in boxes or cartons is necessary to facilitate transportation and protect the plastic skin. Wooden boxes are durable, yet, permit rapid heat transfer between the slats. Cartons are less expensive but tend to insulate the bird against freezer penetration when strong enough to withstand fork-lift stacking. The desire for rapid freezing following use of the subscald has led some processors to devise methods of freezing the product before the final boxing.

Plants Participating in the Study

Detailed plant descriptions, physical inputs and outputs and cost data were obtained for 20 actual plants. All three of the major processing methods were represented. Some had changed recently from one to another and could furnish comparative data for a given set of circumstances. Full coverage of their operations was achieved in 16 plants. A preliminary survey guided the selection of a group representative of the various size categories in current operation. It is estimated that the plants participating in the study handled over 40 per cent of the 1953 California turkey crop.

Certain broad relationships may be established by plotting these plants according to their number of workers, floor space, and output. In Figures 2 and 3, these plants have been distributed according to the dressing and eviscerating room space provided for their respective output capacities rated in turkeys per hour. Dressing floor space requirements are influenced primarily

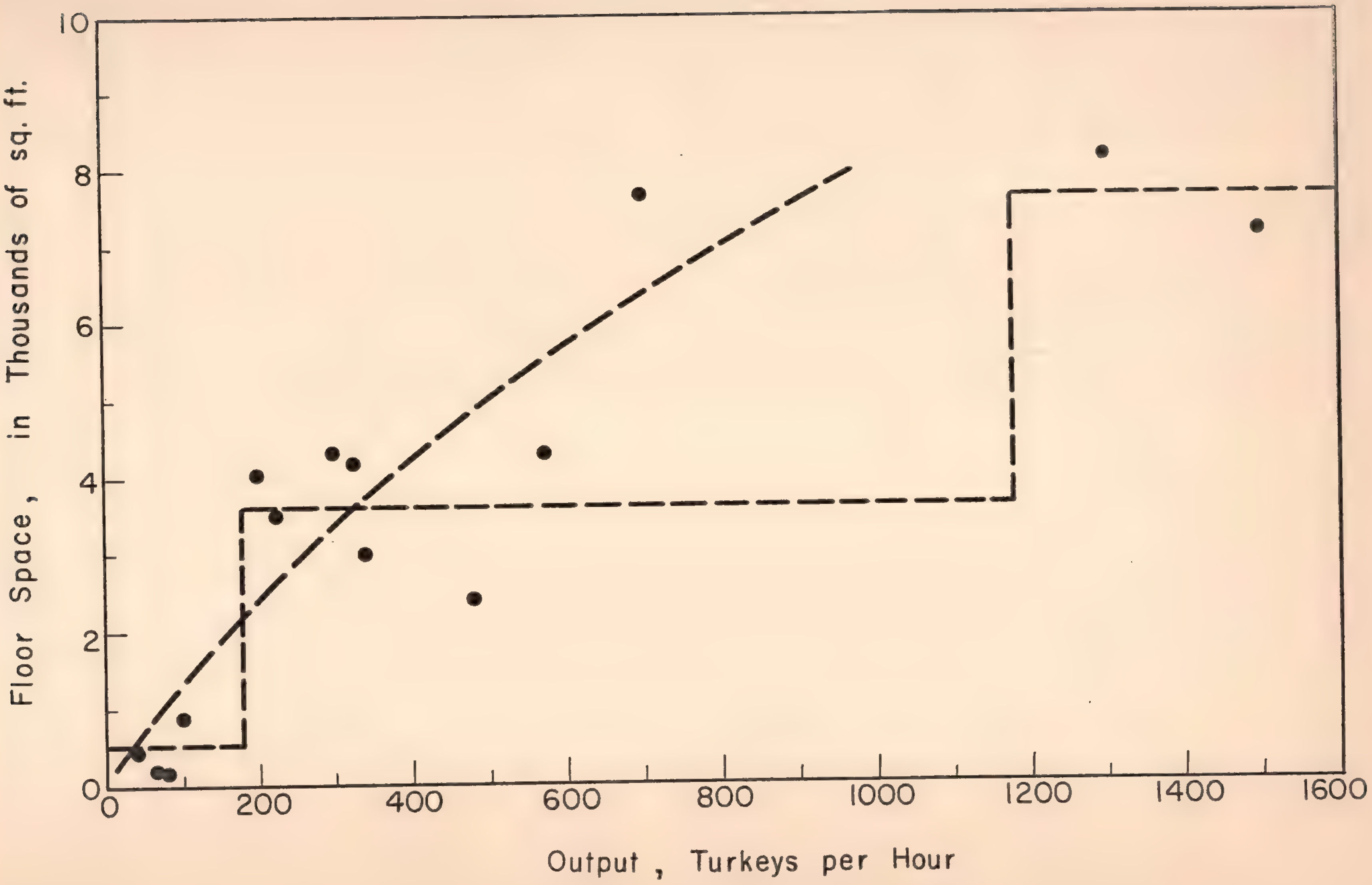


FIGURE 2

Dressing Floor Space in Relation to Output of Turkeys:
California Plants Studied

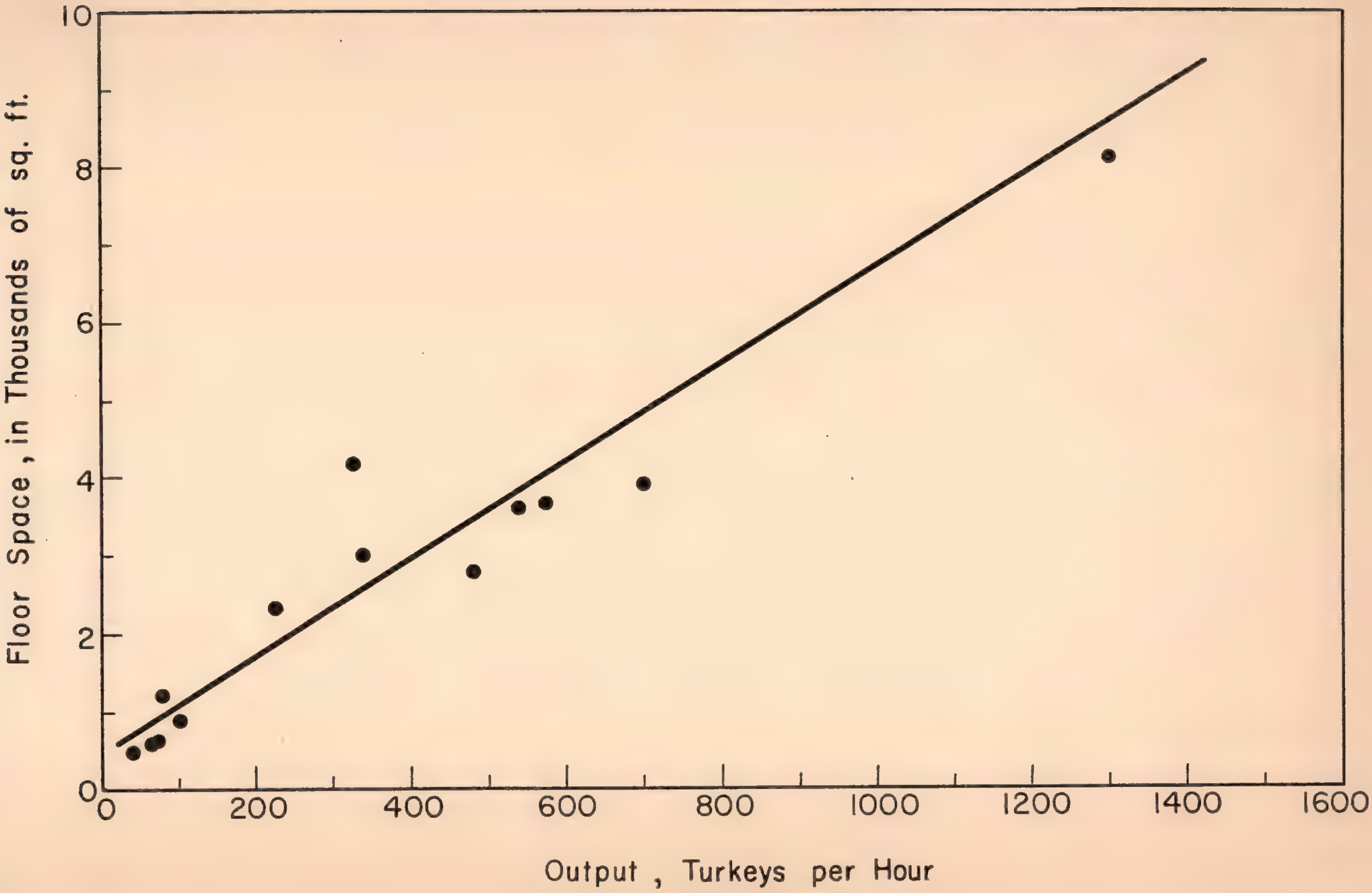


FIGURE 3

Evisceration Floor Space in Relation to Output of Turkeys
California Plants Studied

by the conveyor system employed. The plants fall into three broad groups: those with no automatic conveyor, those with one automatic conveyor line, and these with two. Up to a capacity of possibly 100 birds per hour, one range of space is required. Plants operating above this level all used an automatic conveyor. In this case, much the same amount of space is needed whether the plant handles 200 or 600 turkeys per hour. The plant using 8,000 square feet for an output of 700 birds was laid out on an exceptionally generous basis. The two plants handling over 1,000 birds per hour employed two conveyor lines and occupied approximately twice as much floor space as single conveyor plants. These relationships suggest that dressing floor space requirements increase in steps, the first at an output of 200 turkeys per hour when one conveyor becomes economical, the second at some level around 1,200 per hour when another conveyor is installed.

If the several groups of plants can be viewed in an over-all perspective as homogeneous in function, then, there is a suggestion that the average relationship between floor space and output would follow a curved line. The position of the two largest plants on Figure 2 is evidence of a tendency for increases in output capacity to be associated with economies in space requirements per unit quantity handled.

By contrast, the relationship of evisceration floor space requirements to output conforms fairly closely to a straight-line path and shows little sign of substantial economy with increases in scale.[1]

Study of plants designed originally for New York dressing operations, to which evisceration facilities had been added, indicates that the areas allocated to cooling, boxing, and loading were practically equivalent to the area of an evisceration room of comparable capacity. Space for chilling tanks could be found in picking and cooling areas no longer used. Thus, the total floor space required for New York dressing may be regarded as equivalent to that needed for subscald evisceration without freezing.

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[1] The average relationship between the eviscerating floor space and the output of turkeys per hour for the plants shown in Figure 3 is $Y = 444.771 + 6.2617\,X$, where Y = floor space in square feet and X = output of turkeys per hour. The standard error of estimate σ_Y is 419.2089. This indicates that approximately two thirds of a large number of observations could be expected to lie within such a range of the regression line based on the above equation.

by the conveyor system employed. The plants fall into three broad groups: [illegible] [illegible] with two. At an output of possibly 100 birds per hour, one unit of space is required. Plants operating above this level all used an automatic conveyor. In this case, about the same amount of space is needed whether the plant handles 200 or 600 turkeys per hour. The plant using [illegible] square feet for an output of [illegible] birds was laid out in an exceptionally compact order. The two plants handling over 1,000 birds per hour employed two conveyor lines and occupied approximately twice as much floor space as single conveyor plants. [illegible] steps, the first at an output of 200 turkeys per hour when one conveyor becomes necessary, the second at some level around 1,000 per hour when another conveyor is installed.

If the several groups of plants can be viewed in an over-all progression in function, then, there is a suggestion that the average [illegible] [illegible]. The [illegible] of the two largest plants on figure 2 is evidence of a tendency for increases in output capacity to be associated with economies in space requirements per unit quantity produced.

By contrast, the relationship of eviscerating floor space requirements to output conforms fairly closely to a straight-line pattern; shows little sign of [illegible].[1]

Study of plants designed originally for New York dressing operations, to which evisceration facilities had been added, indicates that the areas allocated to cooling, boxing, and loading were practically equivalent to the area of an eviscerating room of comparable capacity. Space for cutting rooms could be found by dividing the cooling areas no longer used. Thus, the total floor space required for New York dressing can be regarded as equivalent to that [illegible].

---

[1] The average relationship between the eviscerating floor space and the number of turkeys per hour for the plants shown in figure 2 is Y = [illegible] + [illegible] X, where Y = floor space in square feet and X = output of turkeys per hour. The standard error of estimate of Y is [illegible]. This indicates that approximately two-thirds of a large number of observations could be expected to fall within such a range of the regression line based on the above equation.

In Figure 4 subscald and semiscald plants furnishing comparable data have been plotted according to the number of workers required to maintain their dressing operations at normal capacity. Regression lines drawn through each group indicate the average relationship between labor requirements and dressing capacity for each technique.[1] The semiscald plants with large picking and finishing crews increased their dressing staffs approximately in proportion with the number of turkeys handled per hour. Little economy with increasing output is evident in this method of dressing. The scatter of points across the figure is evidence of a fairly wide range in the number of workers used to dress a given volume of turkeys in different plants.

By contrast, the subscald plants achieved marked labor economies. Those operating at rates of 550-750 turkeys per hour employ approximately 20 workers each on dressing, whereas semiscald plants half this size need more than twice as many. Furthermore, some economies of scale are apparent with this method. The tendency, evident in two distinct groups of large and very small farm plants, is for an increase in output to require a much less than proportional increase in the amount of labor. The range in labor/output relationships between the participating plants is relatively narrow both among the farm and the large commercial enterprises. A realistic appraisal of the relationship suggests a step function rising at the point where each additional conveyor line is introduced.

Figure 5 shows similar labor/capacity relationships in ten different eviscerating plants arranged on a comparable basis. Little distinction can be made between subscald and semiscald plants in their evisceration procedures. According to the plants plotted in Figure 5, no significant difference in evisceration labor requirements can be attributed to the type of scald undergone at the dressing stage. The lines indicating the average relationship between labor requirements and output of turkeys in the subscald and semiscald plants, respectively,

---

[1] The regression lines of labor requirements on output of turkeys in Figures 4 and 5 were fitted mathematically. The equations are as follows:

Figure 4: Subscald dressing: $Y = 0.03276\ X - 1.181, \sigma_{XY} = 2.2916$

Semiscald dressing: $Y = 0.14556\ X + 1.264, \sigma_{XY} = 5.8479$

Figure 5: Subscald evisceration: $Y = 0.12376\ X + 8.8228, \sigma_{XY} = 4.1054$

Semiscald evisceration: $Y = 0.1031\ X + 11.6882, \sigma_{XY} = 6.1175$

where Y = number of workers employed (see subsection Labor, p.   for detailed specifications)

X = output of turkeys per hour and

σ_{XY} = standard error of estimate.

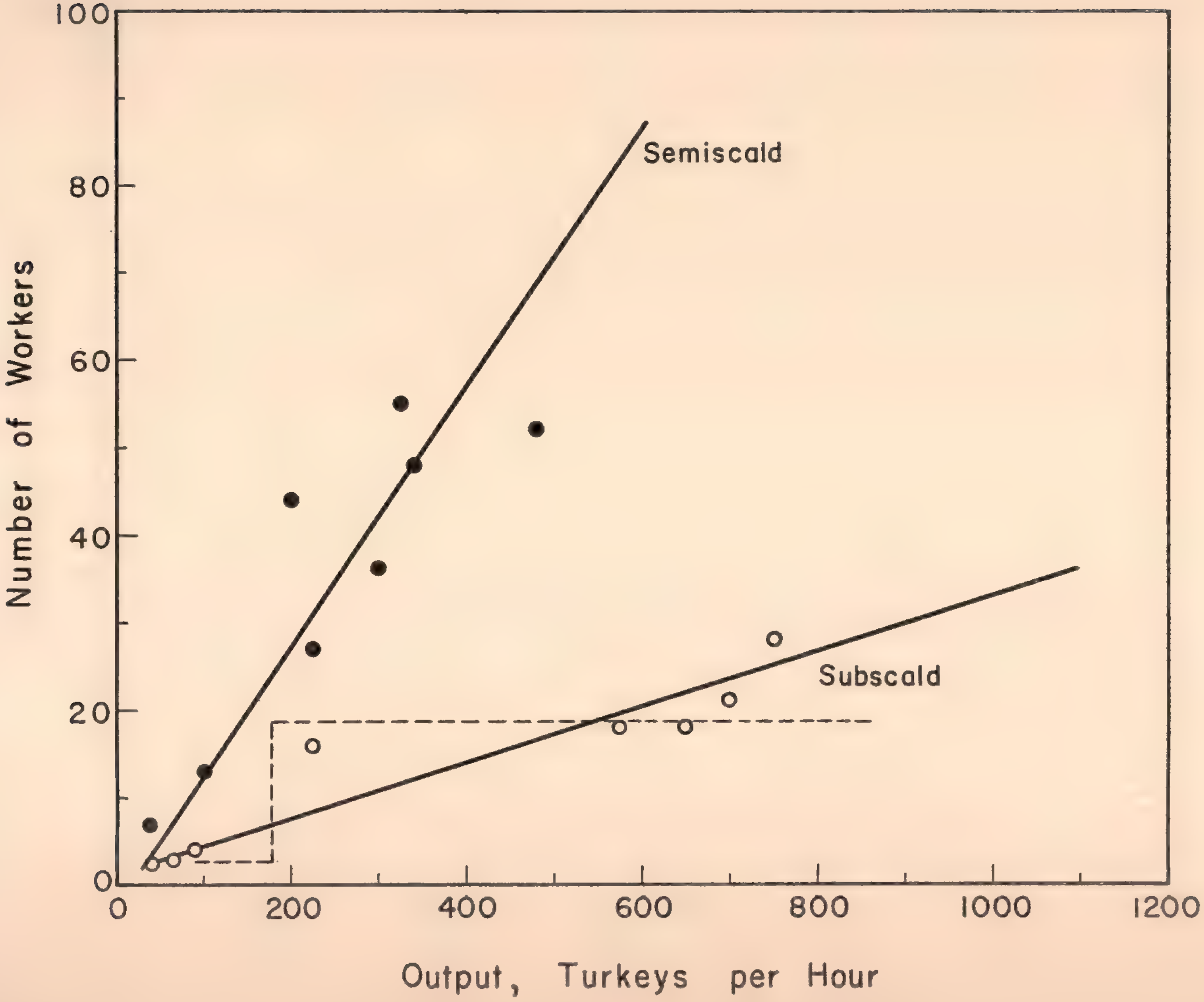

FIGURE 4

Dressing Labor in Relation to Output of Turkeys:
California Subscald and Semiscald Plants Studied

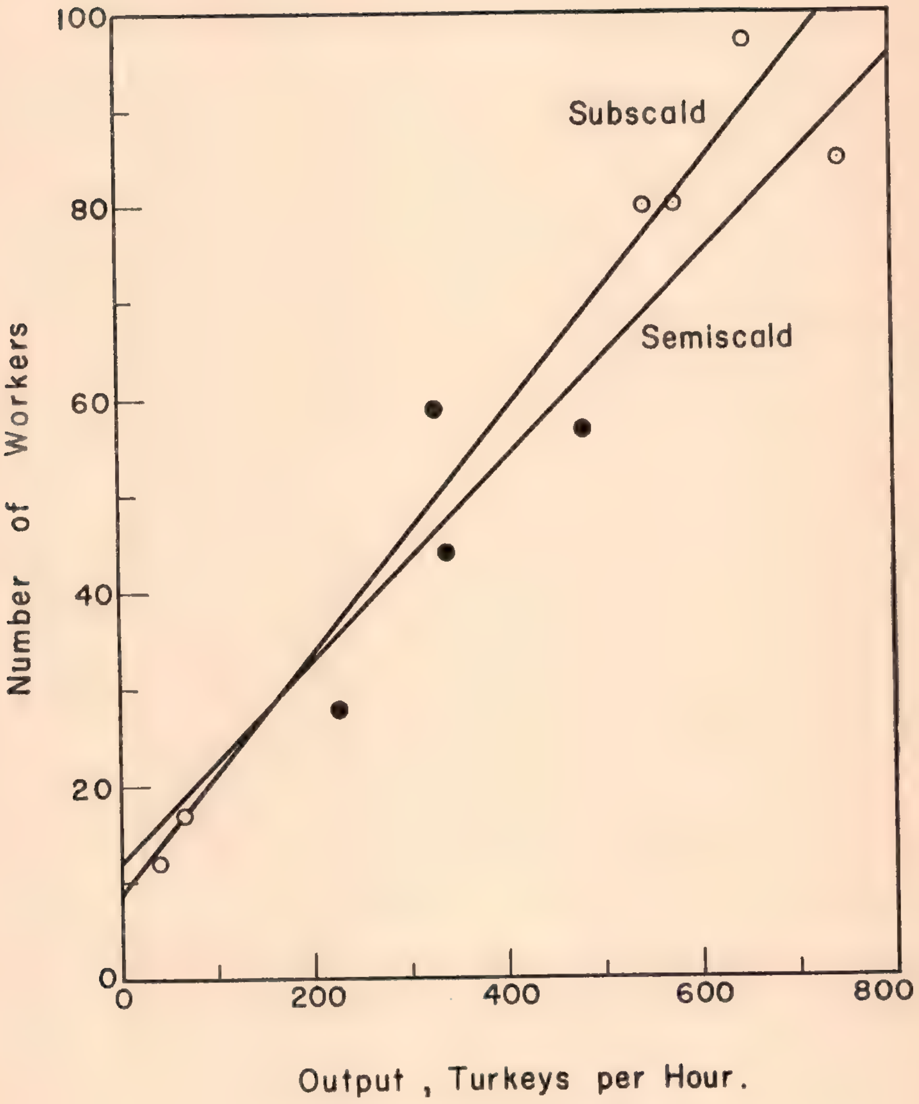

FIGURE 5

Evisceration Labor in Relation to Output of Turkeys:
California Subscald and Semiscald Plants Studied

are almost identical. The positive labor requirement intercept at zero output of turkeys is an indicator of economies with increasing output.

Standardized Plants

The actual plants studied all differed from each other in some respects. Detailed analyses were made in each case as a preliminary to the general study. By agreement with the processors concerned, details of individual enterprises were withheld from publication. Furthermore, scrupulous attention to the idiosyncrasies of particular plants might distract attention from issues of more general interest.

An alternative approach, that of over-all averaging, might tend to cover up critical aspects of the impact of subscald processing on plants of different types. The range of plants and equipment in current use may have an important bearing on the applicability of given techniques. In order to make the most use of the available data, the economic implications of the subscald technique will be analyzed in terms of four modal plants exhibiting broad characteristics fundamental to those observed in current operation. These plants are set up on an increasing scale. Their operating characteristics are based primarily on the averaging of input-output data derived from those plants among the 16 analyzed which approximated to each technical mode.1/

Since the standardized plants purport to represent a reasonable level of efficiency in the light of current techniques, two types of adjustments were considered before the estimate for the standard plant was accepted. First, physical combinations of plant, equipment, labor, and other necessary supplies were checked against manufacturers' and other published specifications on a scale basis. Significant discrepancies were investigated before the data were embodied in the appropriate standardized plant. Second, evident weaknesses in some participating plants were corrected in the light of superior performance in others employing the same system under comparable conditions. The quality of the work was also taken into account. In some cases, lower than average factor inputs at one stage required compensatory additional work at another. Inevitably, such modifications reflect an element of judgment on the part of

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1/ Cf. E. L. Baum, J. E. Faris, and H. C. Walkup who set up five synthetic models on the basis of four observational plants. Economies of Scale in the Operation of Fryer Processing Plants with Special Reference to Washington (Pullman: August, 1952), 33p. (Washington Agricultural Experiment Station Tech. Bul. 7.)

the author and the plant managers, whose statements served as a guide. However, the over-all labor/output or equipment/output ratios applied to the synthetic plants do not exceed those attained in some of the actual plants.

The scale of operation is expressed in terms of turkeys processed per hour. Mechanical conveyor systems and the associated equipment are set up to run at a specific rate. Picking and eviscerating crews work at a place determined, exclusive of interruptions and breakdowns, by the operating rate of the machinery.1/ Customarily, processors try to organize a normal crew appropriate to a predetermined conveyor speed and adjust the over-all output of the plant by varying the number of hours worked.

Hourly rates of 60, 300, 600, and 1,200 turkeys, respectively, have been selected as modal operating rates for turkey plants in California. These rates are representative of the wide range covered by the 16 plants furnishing data for this report. They are not averages but are representative of plant capacities in the industry as a whole.

All rates of operation expressed in terms of birds per time unit are affected by the size of the bird. Fewer toms weighing 30 pounds can be handled in an hour than hens weighing 16 pounds. It will be understood, therefore, that all rates of turkeys processed per hour are average rates for adult Broad Breasted Bronze toms and hens.2/

Furthermore, it will be assumed that the normal output of a plant working on a nominal eight-hour-day basis is that of seven hours' capacity operation.3/ This estimate is founded on observation in actual plants. The legal requirement that female workers receive a 15-minute break in the middle of each four-hour shift absorbs 30 minutes per day. Plant supervisors confirmed that additional delays from discontinuities in feeding the conveyor, inspection requirements,

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1/ The speed of the conveyor is fixed only in the short run. Variable drive equipment permits adaptation of the conveyor rate to the type of product handled, for example, large toms and small hens. However, scalding and chilling facilities must be kept to line with the conveyor and act as a deterrent to departure from certain established rates per product unit.

2/ Small turkeys were not given detailed attention in this project since they were handled by a limited number of plants.

3/ Overtime and additional shifts have been customary during the rush weeks preceding the main holiday markets. The number of hours worked is diminishing as greater use of freezing extends the storage life of the product.

and various mechanical and human breakdowns amount to a further half hour approximately. The minimization of losses from such causes depends on close control over hauling arrangements, plant maintenance, and personnel problems. In plants with long conveyor systems, precise labor planning is necessary to avoid even greater time losses. Workers must arrive and leave on a schedule staggered according to their position along the line. No birds can be left on the line unfinished overnight. However, an attempt to establish a system whereby employees were paid only for the time that birds were passing their station on the line brought serious administrative difficulties.

Technical Requirements

All the plants must meet certain major technical requirements in the processing of turkeys, but the method used may differ according to the type and scale of operation.

1. Assembly. The live turkeys must be conveyed from farm to processing plant at a rate and times appropriate to the smooth and continuous operation of the plant. Except where the processor also handles chickens and thus utilizes vehicles on a year-round basis, the customary practice is to employ outside truckers. The detachable tiered coop bodies are owned by the processor and fitted to hired vehicles when the turkey season begins. The number required is governed by plant capacity and the time taken in loading, unloading, and traveling between farm and plant.
2. Transfer. The birds are taken from the truck and either carried to the killing point by hand or attached to an automatic conveyor. Plants are constructed on a concrete base approached at truck-loading height to facilitate the handling of live birds, ice and supplies, and the ultimate packaged product. An loading bay permits free access to both sides of the vehicle. Shelter is also provided against inclement weather.
3. Rate of killing. This is a critical factor in the operation of the whole plant. Adult Broad Breasted Bronze turkeys were killed by hand in all plants. The automatic killing machinery is best suited to smaller birds.

   Sufficient time must elapse between killing and scalding for proper bleeding. Immersion in water at 140° F. congeals blood not drained away at that stage.

4. Steam. A supply of steam is needed to maintain the scalding tank at a constant temperature, to clean and sterilize equipment, and, under some climatic conditions, to heat the building to comfortable working temperatures. Eviscerating plants require additional steam to shrink the plastic wrap and sterilize equipment.

   All plants beyond the farm size draw steam from a central boiler fired by natural gas. In the farm-size plants, scalding and shrinking tanks are fitted with individual gas or electric heaters.

5. Evisceration. Evisceration may be coordinated with dressing operations in plants with adequate space, equipment, and labor. High standards of cleanliness are demanded since inner surfaces of the carcass are exposed to repeated handling and contact with different pieces of equipment. The structural and sanitary standards required for approval under the U. S. Department of Agriculture inspection rules are notably higher than those customary in dressing plants. A separate eviscerating room is necessary. Its ceiling and walls must have an impermeable washable finish.

6. Chilling. Chilling of the carcass is effected by immersion in ice slush. Reduction of the internal body temperature from over 90° F. to approximately 40° F. is desirable for quality maintenance. The duration of the chilling period ranges from two to four hours according to the size of the bird, proportion of ice to meat, and uniformity of contact with the slush. Air agitation of the slush promotes a more rapid heat transfer. By filling and emptying a succession of tanks, the chilling process can be adapted to a production-line procedure, provided there is some holdover for the morning. Adequate supplies of crushed ice and water are required since sanitary precautions postulate contact with one lot of birds only. On removal from the tanks, birds must be allowed to drain, otherwise surplus water may accumulate as a bloody pool inside the wrapper.

   Theoretically, the most efficient use of chilling water would insure that, on completion of contact with the birds, the temperature of the water had risen to that of the birds on first entering the water thus maximizing its cooling effect. Heat

exchange would take place in a tube or trough. Water and birds would travel from opposite directions in accordance with the continuous cooling principle and to insure maximum agitation and contact.

The coldest water would thus meet birds already partially chilled, the warmest, those with a high initial temperature. In this way, the heat reduction potential of the cooling medium is fully exploited. Methods of adapting continuous water cooling to the sanitary and economic requirements of poultry plants are under consideration.[1] In view of its relative inefficiency in terms both of physical engineering and labor use criteria, the present method of batch chilling should be regarded as a temporary expedient.

7. Packaging. Enclosure of eviscerated turkeys in plastic bags is now customary as a protection against contamination and an aid in retail display. Trade names and other information may be printed on the bag. Withdrawal of the air by means of a vacuum pump and steam shrinking of the plastic to fit tightly to the contours of the product further enhance its appearance and shelf life. Both subscalded and semiscalded eviscerated birds are so treated.

8. Freezing. The bulk of the eviscerated turkey handled in California is now frozen. Preferred conditions are 40° F. for the initial quick freeze and 10°-0° F. in the holding room. In most parts of the state, custom freezers are available wherein the product may be quick frozen, stored, and loaded out at the processor's order. Alternatively, processors interested in retail sales or close control over the detailed use of the freezer may install the necessary equipment and insulated space at their own plant.

Plant Layouts

The standardized plans that follow are not copied from any specific existing plants but represent manufacturers' proposed layouts as reflected in California practice. These designs have been formulated to allow for prospective

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[1] For example, designs proposed by G. F. Stewart, Department of Poultry Husbandry, University of California, Davis, and C. K. Swanson, Inc., Modesto, California.

changes in procedure. They conform to the general principles of plant production flow advocated by construction engineers and poultry processing machinery manufacturers.

The plants are designed primarily for subscald picking, evisceration, and packaging. In each case, the facilities are compared with those needed for semiscald evisceration and New York dressing on the same scale. Allowance is made for offices, washroom facilities, and storage rooms.1/ It is presumed that each day's output is moved immediately to a commercial freezer. The design, however, allows for the construction of convenient quick-freeze and holding rooms if it should be considered desirable.

The processing equipment used in each plant has been selected to make maximum use of the designs cataloged by the leading manufacturers, consistent with contemporary practice. The techniques do not purport to be the most advanced in use, but practice has shown them to be reasonably sound.

Plant A, rated at 60 birds per hour, is designed to meet the requirements of the grower-processor. Its prime purpose is to prepare the owners' own flock for retail customers. Total output for the year would range from 5,000-15,000 turkeys concentrated mainly in the weeks preceding Thanksgiving and Christmas. Such plants are usually located in converted farm buildings. Natural differences in ground level or cuttings may be used to facilitate truck loading and unloading. Characteristics would be a relatively low investment in buildings and equipment, high labor use, intense activity for short seasonal periods, and personal supervision of all operations by a working manager, usually the owner.

The plant design provides for a continuous flow of product between work stations each situated within arm's reach of the next since there is no automatic conveyor. Birds are hung on shackles for killing and pushed around on the shackle to the scalding tank and picking drum. This drum is set in the wall of the building so that the wet feathers are thrown outside. Birds then proceed to washing tank, pinning table, evisceration, and ice chilling. Finally, they are hung on racks to drain. Provision is made for plastic wrap packaging, weighing, and boxing. A central passageway is kept open to facilitate the movement of giblets, ice, and general personnel. There is also space to maneuver a hand truck. The

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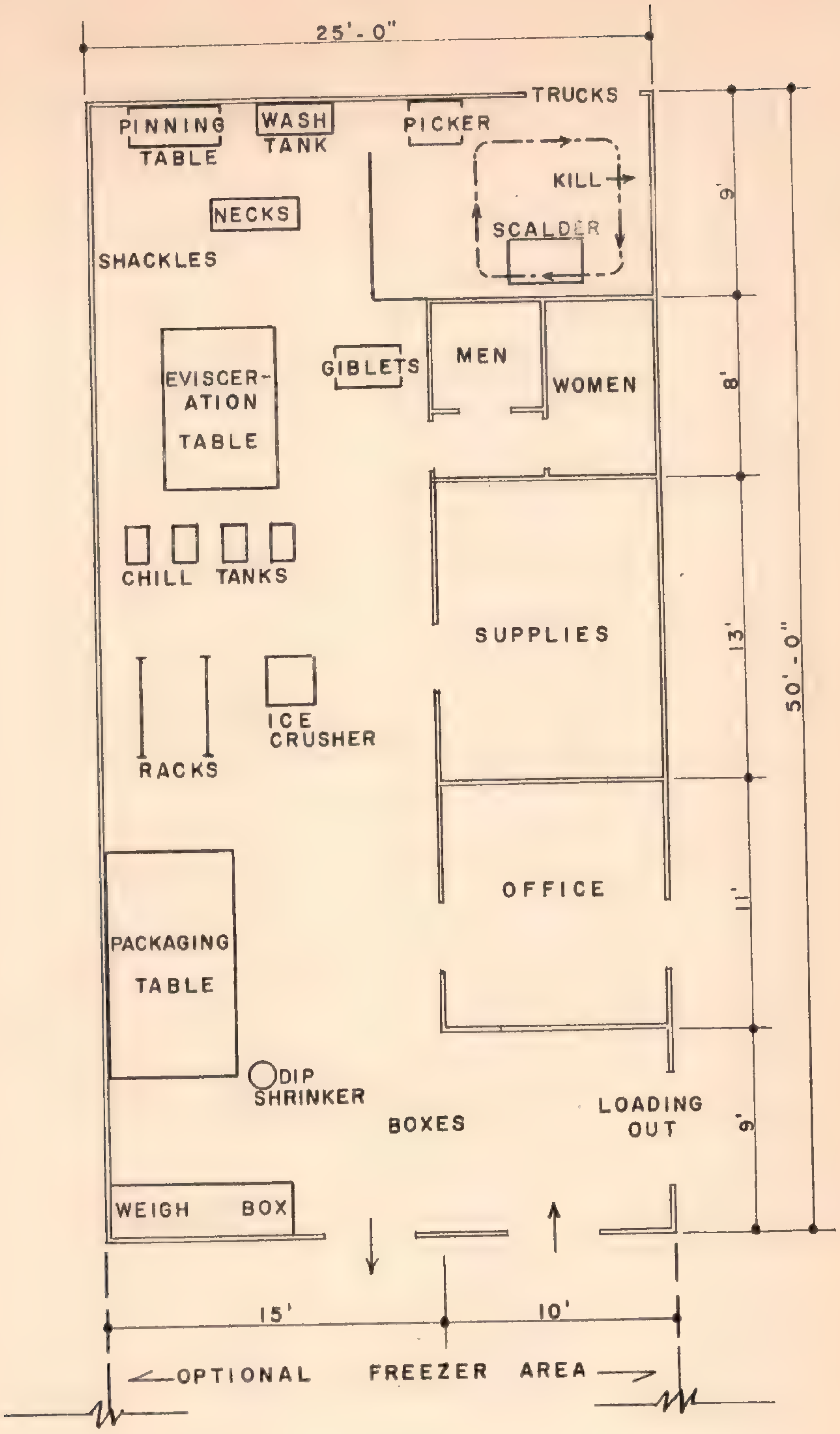
1/ Blood, feathers, and other waste are washed away by water or removed in bins and trucks. Some plants have experimented with mechanical refuse disposal systems. In many cases, disposal costs were covered by sales for fertilizer and like uses. In one plant, certain wing feathers were collected for use in the manufacture of arrows.



PLANT "A" (60 Turkeys per Hour, Subscald.)

Scale :

packaged product is ready for loading out or transfer to a freezer located at the end of the present building. A small office is situated in a convenient position to control the final stages and handle retail sales. The dimensions of the standardized plant are slightly larger than those of the most efficient actual plants of this type since the operators of these plants complained of congestion.

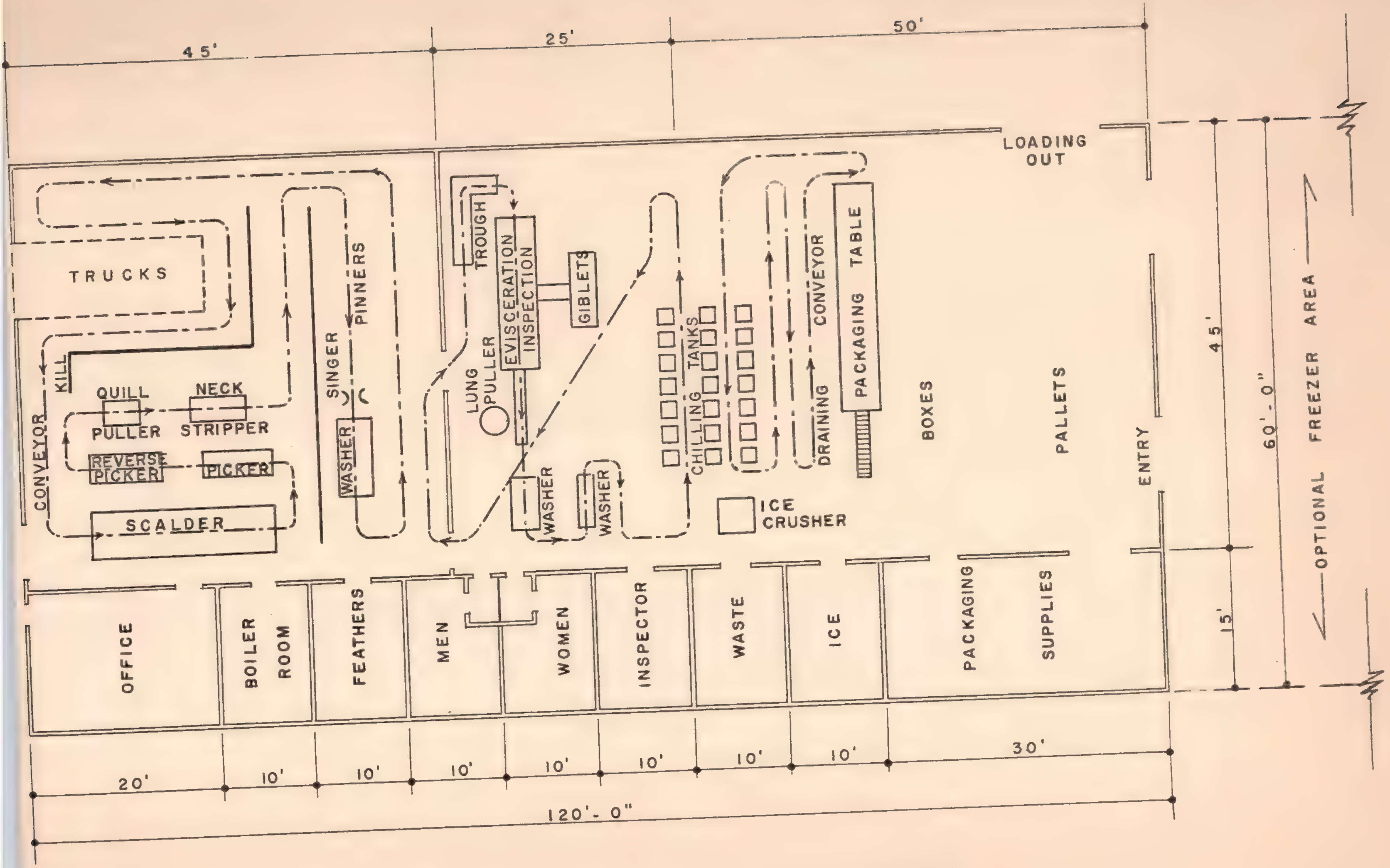
Semiscald processing in plant A would require additional space for a supplementary picking crew. An extension 12' x 10' might be needed to accommodate eight women pickers drawing birds from the main washing tank.

Operation of plant A solely as a New York dressing enterprise would eliminate the need for eviscerating equipment, ice chilling, and individual packaging. This space would be given over to a semiscald finishing crew and a 34° F. cool room. In practice, a low level of sanitary requirements have enabled many farmers to carry out seasonal New York dressing operations in buildings normally used for other purposes.

Plant B (300 per hour) represents an adaptation of the smaller semiscald conveyor plants to the subscald method. It incorporates a series of mechanical pickers, washers, etc., past which the birds are carried on shackles suspended from a moving chain. Workers are stationed at intervals along the conveyor line to supplement the automatic equipment and to complete the process of dressing, eviscerating, chilling, packaging, and dispatching the product to storerooms or freezer.

The various pieces of equipment are arranged to take up the minimum amount of space consistent with accessibility to the disposal dock for adjustment and the removal of feathers. A bleeding period of three minutes between killing and scalding presupposes a distance of 25 feet between these stages on this conveyor. The second conveyor enters the dressing room to pick up dressed birds and carries them into the evisceration room through a gap in the wall.

Location of the chilling tanks in a central position minimizes the distance the tanks are moved in filling, emptying, and stocking with ice. In the plants most completely adapted to slush chilling, ice is distributed by overhead augers and chutes. Birds from the chilling tanks are hung on an extended conveyor which delivers them to the packaging table after allowing time for surplus water to drain off. The boxmaking or carton store is convenient for the terminal end of the packaging table. There is space to maneuver fork-lift trucks and pallets in transporting full boxes into either an attached or independent freezer. An advantage of this general design is that direct access to boiler, feather, waste,



PLANT "B" (300 Turkeys per Hour, Subscald.)

Scale: 0 5 10 15 Ft.

and supply rooms can be arranged by means of doors at the side of the building, and contact between the food product and waste materials is thus minimized. Rail cars can be serviced from loading doors on the opposite side.

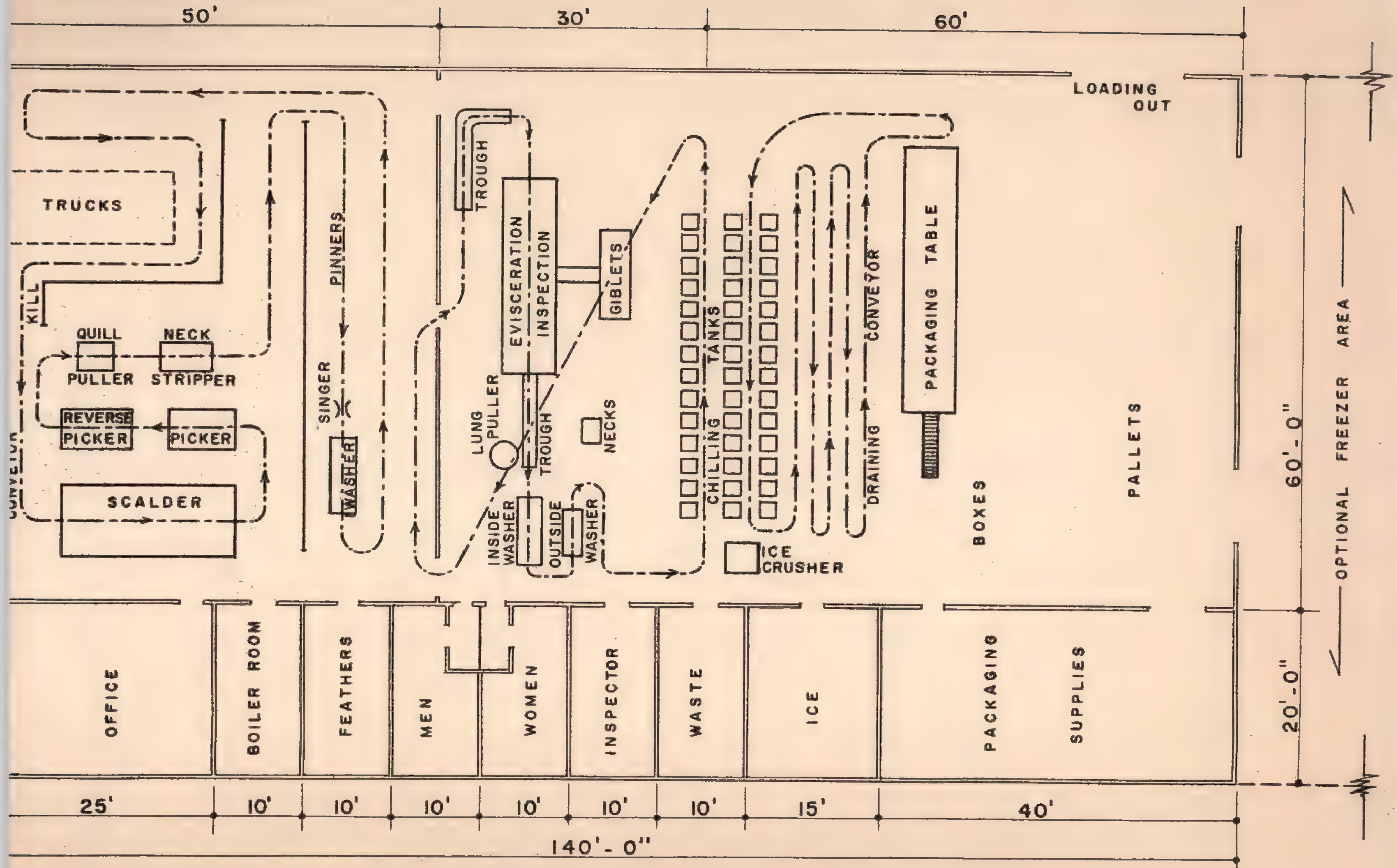
The operation of Plant B on a semiscald basis would require additional space and conveyor equipment to accommodate extra picking and pinning lines, with a proportional increase in facilities for the larger staff.

A New York dressing plant of B capacity would require the same dressing conveyor facilities as the semiscald eviscerating plant. Movable racks and a cool room replace the ice chilling and eviscerating equipment. The same boxmaking facilities are required, but New York dressed birds are boxed directly from the racks, generally without individual weighing and packaging.

Plant C (600 per hour) differs little in character from B except that additional or larger pieces of similar equipment have been installed, and more labor has been applied to permit faster movement of the conveyor. Not all labor stations require double the staff used in B. Some operations may be broken down into more specialized tasks. More space is required to permit use of these additional machines and labor units and to store the increased reserves of packaging supplies. The layout is the same.

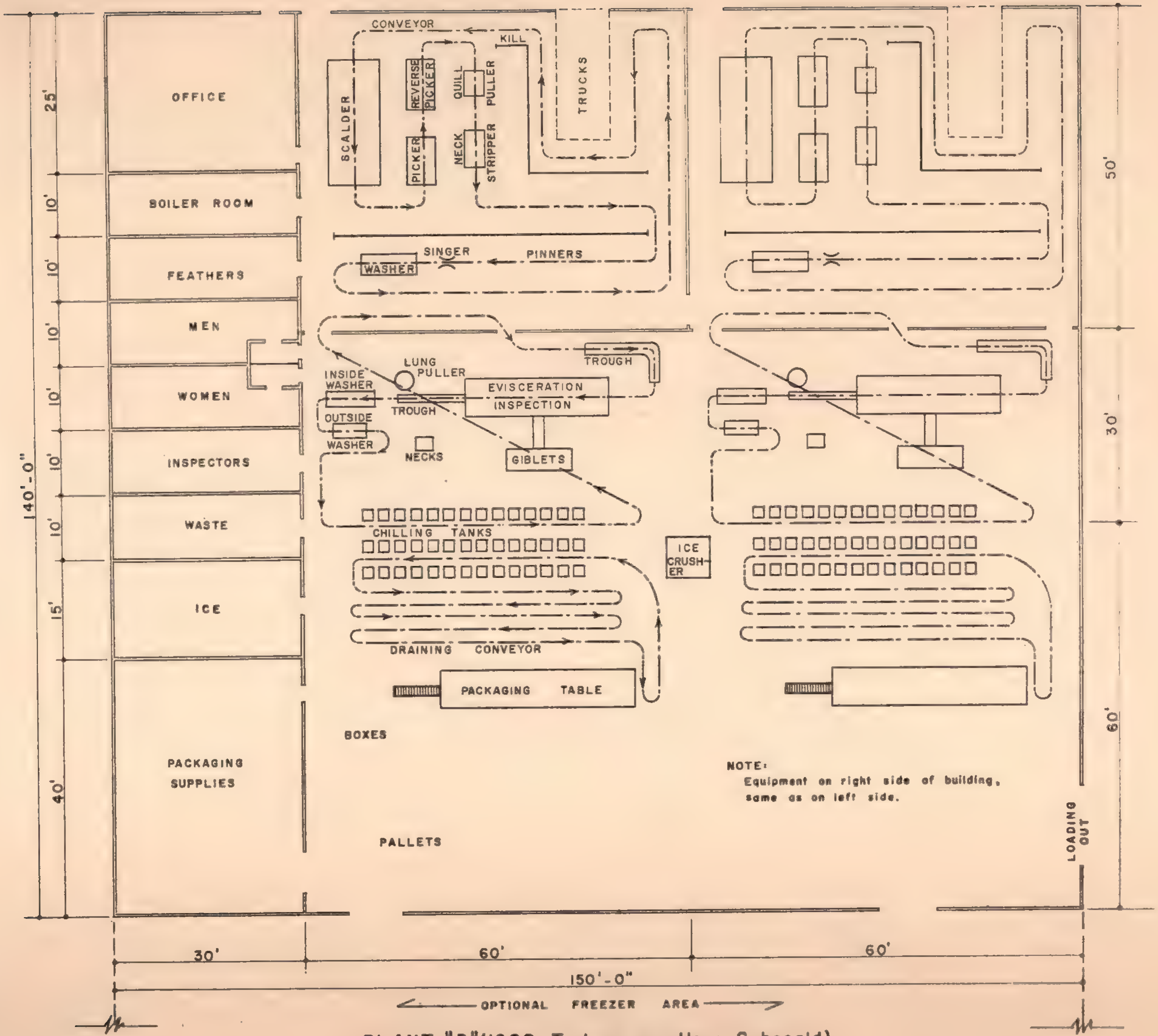
Plant D (1,200 turkeys per hour) has two of the conveyor lines and equipment balances employed in C set up in parallel. Those plants observed operating at this rate per hour used this method. They incorporated no machinery designed specifically to accommodate such a high rate. However, one centrally situated ice crusher appeared to be ample for both lines in the absence of an overhead crushed-ice service.

Power fork-lift machinery can be substituted for hand-lift trucks to a greater extent in a plant of this size where movement of the product from both lines can be handled as one unit task; otherwise, C and D do not differ in level of intensity in the application of machinery to the main function of processing the live turkey. A and B employed less machinery because their turnover did not warrant the additional investment, building space, and labor associated with greater intensification. Plant D has gone no further than C, either because the current level of design has nothing advantageous to offer or because the management wishes to retain flexibility. Plant D can be operated efficiently with half its capacity labor crew. Plant B and C require the presence of practically a full crew if they are to operate at all.



PLANT "C" (600 Turkeys per Hour, Subscald.)

Scale: 0 5 10 15 Ft.



PLANT "D"(1200 Turkeys per Hour, Subscald).

Scale: 0 5 10 15 Ft.

Cost Estimates

Detailed cost estimates are presented for subscald and semiscald evisceration in each of the standardized turkey plants. The major cost elements are treated separately. The incidence of each item upon the different sized plants is discussed first in terms of physical units, secondly, in money values. Construction, equipment, and supply factor prices are estimated on a uniform basis in order to eliminate bias from historical influences and business associations particular to the actual enterprises studied. However, where supply prices reflect consistently the scale of the purchaser, the cost estimates for the standardized plants have been formulated accordingly.

The various cost elements in processing turkeys range between those directly related to the volume of product handled and those incurred whether the plant is in operation or not. The total of fixed costs is not affected by the amount of work performed. The burden of fixed costs per unit of product diminishes as the total amount of product handled increases. Variable costs are incurred only when the plant is in operation. They may be governed primarily by the amount of product handled or by the time period of operation.

Fixed Costs

The chief factors determining the level of fixed costs include investment in plant and equipment, expenses incurred maintaining it in condition to operate when needed, and property taxes. Interest and depreciation allowances on the capital invested in the plant are a major consideration determining the level of expenditure on buildings and equipment a processor can afford. The income anticipated must be adequate to meet all charges, pay off the total investment at a rate at least equal to its decline in value, and give some return on the capital. Insurance protects the owner of the investment against risks. Local property taxes are incurred annually irrespective of the use made of the property concerned.

Repairs and maintenance work must be carried out regularly if buildings and equipment are to serve their purpose efficiently and retain their value. In the sense that part at least of such expenditures may be postponed, repair costs are not truly fixed. However, sound managerial policies provide for regular maintenance as a protection against more serious replacements.

Certain administrative expenses may be regarded as fixed costs. Plant managerial staff, office workers, and such other supervisory or maintenance workers

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[illegible] tion in each of the standardized turkey plants. The major cost elements are treated separately. The incidence of each item upon the different-sized plants is discussed first in terms of physical units, secondly, in money values. Construction, equipment, and supply factor prices are estimated on a uniform basis in order to eliminate bias from historical influences and business decisions particular to the actual enterprises studied. However, where supply prices reflect considerably the scale of the purchaser, the cost estimates for the standardized plants have been formulated accordingly.

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Repairs and maintenance work must be carried out regularly if buildings and equipment are to serve their purpose efficiently and hold their value. In the sense that part at least of such expenditures may be postponed, repair costs are not truly fixed. However, sound managerial policies prescribe regular maintenance as a protection against more serious replacements.

Certain administrative expenses may be regarded as fixed costs. [illegible] staff, office workers, and such other supervisory or maintenance workers as are employed throughout the year whether or not the plant is in operation also become a fixed cost burden. The level of fixed administrative expenses is governed by the structure of the particular firm, the size and complexity of its work force, and its salary policy.

Most fixed plant costs are assessed in terms of the total investment in land, buildings, and machinery. Arbitrary percentages are applied in accordance with local and industry practices, the rates acceptable to the income tax authorities, the amount of risk particular operators will shoulder, and their ease of access to investment funds. Since the reflection of circumstances specific to certain firms would divert attention from the general cost interrelationships between techniques and scale, these costs will be assessed on a standard basis for all plants.

In practice, firms acquire their buildings under different circumstances, impute historical rather than market valuations, and make alterations and improvements under different cost circumstances. Various materials and types of construction may be employed. Similarly, the equipment used in the plant may be acquired at different dates and from different manufacturers under varying cost circumstances. The influence of such extraneous factors will be excluded. All investments in land, building, and equipment items will be pricedon a standard current replacement cost basis as of the 1953 season. Few processors, especially of the farm or smaller commercial types, operate plants actually bearing investment costs on this level. Nevertheless, these relationships will be of interest as indicative of the probable outlay if they build new plants under contemporary conditions.

Land.--The land requirements of a turkey processing plant include space for the current enterprise and possible expansion. Additional land is needed to permit unimpeded vehicular access to the various parts of the plant and provide adequate parking and outside storage areas.

Sanitary and zoning ordinances generally preclude location in concentrated city areas or established residential districts. Convenience with respect to farm suppliers, labor resources, rail transport facilities, and cold storage and ice plants are the strategic considerations. Proximity to a market is relatively unimportant when the whole of the product is packed for long-distance transportation, whether sold locally or not.

Currently, the largest firms are situated on the outskirts of medium-sized cities in the center of the producing area. Other commercial plants are found in the industrial areas of small cities in general agricultural areas. The

cost of the land on which the processing plant is situated is determined by the level of economic activity in the area and the availability of the necessary services.

Table 3 shows the investment in land assumed for each plant. The land component of the fixed investment will be assessed interest and tax charges on the same basis as the building situated thereon. A comparable maintenance expense is also allowed. Drainage, fencing, paving, and sewerage will be assumed covered by the replacement cost of the land and buildings and the standardized charges based on it.

TABLE 3

Investment in Land for Turkey Processing Plants

Plant	Turkeys per hour	Acres	Dollars	Location
A	60	1/4	75	Unirrigated farm land
B	300	1/2	500	An agricultural center with transportation and refrigeration facilities
C	600	1	1,750	Outskirts of a city with ample seasonal labor resources, transport and refrigeration facilities
D	1,200	1-1/2	2,625	

Buildings.--Two major factors govern the cost of poultry processing plant structures under contemporary conditions: conformity to U. S. Department of Agriculture sanitary inspection standards and the nature of the materials employed. In practice these two factors are closely interrelated. Full adherence to the requirements of the sanitary code restricts the selection of materials used in construction. The general practice is to permit the continuance of operations in existing plants, even where conformity is not complete, but to require that all newly constructed plants obtain approval. Obligatory local sanitary standards may be less exacting.

In any event, the sanitary code is designed to protect the product from contamination during processing. Insofar as its ultimate quality and shelf life is enhanced by freedom from such contamination, the processor gains in market acceptance of his product.

Conformity with the federal inspection code requires that "ceilings and walls in rooms and compartments where exposed edible products are processed, handled or stored shall have tiled, enameled or other smooth surface imprevious to moisture."[1/] Firms operating in unsuitable buildings have lined the necessary parts with concrete to conform with this order if they desired the "U. S. inspected" stamp on their product. Since sanitary authorities envisage ultimately enforcing these regulations on all processors, the construction costs for the model plants will be assessed under the assumption that evisceration and packing areas conform to the regulations.

Various materials have been used in the construction of plants now in operation as turkey processing units. Concrete, brick, corrugated metal, and wooden buildings are all in current use. At 1953 price levels for materials and labor, wooden structures show little cost advantage considering their lower durability, greater susceptibility to fire, and the unsuitability of their inner walls for rooms where edible products are exposed.

Steel frame structures with aluminum sheet walls and roof cost much the same as wooden buildings. Sheet metal is not, however, acceptable as a sanitary surface in evisceration rooms because of the joints and seams, although New York dressing operations might be carried on in such a structure. Eviscerating and packaging areas would require an additional inner walling of smooth concrete and a full ceiling. One set of estimates for the construction of plants A, B, C, and D has been prepared on such a basis.

A second series provides for a building constructed throughout of concrete or block walls about a steel frame. The roof is built up of asphalt and tar paper on a wide-span basis. A full ceiling is provided over the whole area. The eviscerating and packaging room walls are finished with an additional smooth washable plaster.

Composite metal and concrete structures may also be envisaged since concrete is more expensive and processors may be interested in obtaining the lowest cost structure acceptable to the sanitary authorities. The larger plants may have dressing and storage areas of metal and evisceration and packaging areas of concrete with plaster ceilings. The nature of plant A is not conducive to economical division into two independent structures.

[1/] U. S. Production and Marketing Administration, Regulations Governing the Grading and Inspection of Poultry and Edible Products Thereof and United States Classes, Standards, and Grades with Respect Thereto (Washington, Govt. Print. Off., April 18, 1952), p. 11. (82nd Cong., 60 Stat. 1087, Pub. Law 135.)

Observation of new plants constructed specifically for poultry processing indicates that 12 feet is a practical height for walls and ceilings throughout the building. Adequate head room facilitates ventilation and the installation of overhead conveyor lines.

All plants are constructed on a concrete base sloped to give adequate drainage and fitted with covered gutters and outside drains. In plants B, C, and D the base is so related to the surrounding terrain that trucks and rail cars may approach at convenient loading height for the main working floor. All buildings are of the single-floor type.

These plants are equipped with the detailed electrical and water lines and plumbing facilities necessary to serve the equipment installed. Office, toilet, and accessory service accommodation is furnished on the same basis.

The designs for New York dressing provide for ice chilling but not refrigeration. If freezing facilities are installed, the insulated areas and machinery must be housed in an additional structure.

The total cost of constructing the model plants under the various conditions specified is computed according to estimating methods recommended by two firms of commercial contractors and checked by an independent engineer.1/ Table 4 summarizes these estimates.

Under most circumstances, the combination building of metal and concrete would incur the minimum capital investment (and annual fixed cost. See Table 7 et seq.). This type will be adapted as a basis for the estimation of annual fixed building costs. Firms about to invest in a new plant for poultry processing purposes might, however, prefer a wholly concrete or brick structure for resale or prestige reasons.

Semiscald evisceration plants cost more than subscald plants of the same capacity because of the additional picking space required. The difference in construction costs between a New York dressing plant and a subscald evisceration plant ranges from some 15-35 per cent. The commercial evisceration sizes, metal with concrete linings, cost 15 per cent more than comparable metal New York dressing plants. The farm (metal and concrete) and commercial (concrete) sizes cost 30-35 per cent more. Inside walls and ceilings account for most of the additional expenditure.

1/ W. W. Halverstall, Hub City Erection Co., Sacramento; H. R. Priestadt, Jr., Reynolds Metal Co., San Francisco; and L. L. Sammet, Department of Agricultural Economics, University of California, Berkeley. For details, see Appendix Table I.

TABLE 4

Estimated Construction Costs for Turkey Processing Plants, 1953

Plant	Hourly capacity	Floor space	Building cost: Metal sheet lined as necessary	Building cost: Concrete	Building cost: Combination metal and concrete
	turkeys	square feet	dollars		
Subscald evisceration					
A	60	1,250	8,200	10,500	--
B	300	7,200	48,100	52,900	47,200
C	600	11,200	73,900	77,900	70,900
D	1,200	21,000	136,300	136,400	127,400
Semiscald evisceration					
A	60	1,370	8,800	11,400	--
B	300	8,400	55,600	61,000	54,700
C	600	12,800	83,900	88,400	80,900
D	1,200	24,000	154,600	155,000	145,700
New York dressing					
A	80	1,250	5,900	7,700	--
B	300	7,200	41,400	40,300	--
C	600	11,200	64,300	60,100	--
D	1,200	21,000	119,600	106,500	--

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Table 5 compares the cost of quarters constructed under various conditions of scale and building material in terms of processing capacity. On this basis the farm structure is more economical than the smallest commercial plant. But the larger commercial plants profit by each increase in size. Costs of wall construction per square foot of floor space decline as the floor area increases. However, the effect of this relationship is modified by greater expenditure on roofing, interior walls, and services.

Equipment.--Each of the standardized plants was furnished with an appropriate balance of equipment for the size and technique concerned. Selection was guided by 1953 practice in the California plants studied. To this extent the equipment relationships may reflect a tendency for firms to continue using installed machinery after other changes have reduced its significance.[1] However, an overgenerous allowance for automatic machinery may cover incidental accessories not distinguished in plant inventories but vital to smooth operation.

Equipment prices are based on information supplied by manufacturers.[2] All include freight charges to central California, sales tax, and an allowance for installation. Where several models of a piece of equipment are available, the lowest priced of those observed in satisfactory operation has been selected.

Table 6 summarizes the estimated replacement cost of the equipment in turkey processing plants of increasing scale. The equipment cost of Plant A is low largely because it operates without the automatic conveyor system. Equipment is manufactured specifically for such conditions.[3] Equipment costs disproportionate to capacity, as between plants B and C, are the result of technical indivisability. Most pieces of equipment are made only in a limited number of sizes. The smallest design may still be larger than is necessary for the smaller plants. Furthermore, machines designed to operate on a small scale may cost almost as much to construct and install as the largest model of the same type. Alternatively,

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[1] For example, processors employ automatic flame singers to remove body hairs. After subscald picking, which leaves the carcass moist and sticky, the singeing procedure has doubtful value.

[2] Barker Poultry Equipment Co., Modesto; Gordon Johnson Equipment Co., Kansas City; Dewey and Almy Chemical Co., San Leandro; Pickwick Sales Co., Monterey Park; Toledo Scale Co., Sacramento; Cleaver Brooks Boiler Co., San Francisco; Yale and Towne Manufacturing Co., San Francisco; Lewis Shepard Co., San Francisco; and Acme Metal Products Co., San Francisco.

[3] Some farm processors are able to cut their investment costs substantially by substituting homemade tables, machinery, etc., for the manufacturers' product. Thus, the domestic vacuum cleaner, rubber bands, and hand dipping in a tank heated by a conventional gas jet may be used instead of the small "Cry-o-vac" packaging model.

TABLE 5

Estimated Construction Costs for Turkey Processing Plants in Relation to Hourly Capacity, 1953

Plant	Hourly capacity	Floor space per hourly unit capacity	Building cost per hourly unit capacity		
			Metal sheet lined as necessary	Concrete	Combination metal and concrete
	turkeys	square feet	dollars		
Subscald evisceration					
A	60	20.8	137	175	--
B	300	24.0	160	176	157
C	600	18.7	123	130	118
D	1,200	17.5	114	114	106
Semiscald evisceration					
A	60	22.8	147	190	--
B	300	28.0	185	203	182
C	600	21.3	140	147	135
D	1,200	20.0	127	129	121
New York dressing					
A	60	20.8	99	128	--
B	300	24.0	138	134	--
C	600	18.7	107	100	--
D	1,200	17.5	100	89	--

TABLE 6

Estimated Investment in Equipment for Turkey Processing Plants, 1953

Equipment	Plant							
	A		B		C		D	
	Subscald evisceration	Semiscald evisceration	Subscald evisceration	Semiscald evisceration	Subscald evisceration	Semiscald evisceration	Subscald evisceration	Semiscald evisceration
	dollars							
Truck coop bodies[a]	400	400	2,640	2,640	4,400	4,400	8,800	8,800
Conveyor[b]			8,200	8,850	11,465	12,245	22,930	24,490
Scalder	1,100	1,100	3,720	3,720	3,720	3,720	7,440	7,440
Pickers			7,650	7,650	8,250	8,250	16,500	16,500
Washers, singer	75	75	3,726	3,726	3,726	3,726	7,452	7,452
Evisceration tables, troughs	700	700	5,930	5,930	9,040	9,040	18,080	18,080
Gizzard peeler, lung puller			2,985	2,985	3,425	3,425	6,850	6,850
Ice tanks, crusher[c]	640	640	3,720	3,720	7,080	7,080	13,800	13,800
Racks	200	200						
Packaging tables	150	150	1,890	1,890	2,360	2,360	4,720	4,720
Packaging machinery[d]	650	650	3,350	3,350	4,500	4,500	9,000	9,000
Weighing and adding machines	170	170	315	315	485	485	970	970
Fork-lift trucks, pallets[e]			1,694	1,694	9,495	9,495	17,960	17,960
Bins, trucks, tools, etc.	65	65	200	200	300	300	600	600
Boiler			4,000	4,000	4,350	4,350	6,150	6,150
Total	4,150	4,150	50,020	50,670	72,596	73,376	141,252	142,812

a/ Assuming that a three-tiered coop body approximately 20' x 8' holds 500 average adult turkeys, two loads are carried per day and a reserve is maintained for emergencies.

b/ Single level open track is provided for dressing operations, the more expensive enclosed, and variable level conveyor, for eviscerating and packaging lines. The packaging line is set up to allow a 20-minute draining period, assuming 20 inches between birds.

c/ Chilling tanks are allocated on a basis of a four-hour chilling period and a tank capacity of 50 birds.

d/ Including shaping machinery, plastic bag vacuum pump, clip fastener, shrinking equipment, and carton stapler.

e/ Pallet stacking and movement is provided at the packaging stage in all the commercial plants. Hand-operated fork trucks with a 3-inch lift are used in B, power-lift high stacking trucks are provided in C and D.

a firm may install a larger machine than is strictly necessary and work it at less than capacity. Divisible or partly divisible equipment, such as ice-chilling tanks and conveyor sections, may be adjusted quite closely to the requirements of the plant.

There is little difference in total dressing and evisceration equipment costs between subscald and semiscald plants.

Depreciation.--The most serious consideration in the purchase of equipment for poultry processing plants is the effective rate of depreciation and the returns likely to accrue during its use life. Depreciation is determined as much by time and the rate of obsolescence as by the amount of use obtained.

A soundly constructed, open-floor building can house various technical processes and has a number of alternative uses. Thus, its depreciation would reflect primarily the effect of time on the physical structure and its use life be comparable to that of the general class of such buildings.

Specialized equipment, though able to perform the task for which it is designed over a longer period, may find its economic use life cut short abruptly by the advent of new models able to carry out the same work at less cost. An environment of rapid technical change has been characteristic of the poultry processing industry in recent years. Manufacturers of such equipment advise processors to expect only four years of economic life. The normal depreciation allowance for processing equipment approved by taxation authorities generally presumes a longer use life than is customary in the industry. The rates selected appear in Table 7.

They are set high for equipment considered vulnerable to obsolescence in order to approach the position of actual processors. It is not intended, however, that these rates should reflect the business risk of the owner.

Interest.--Whether it take the form of rent, mortgage interest, or sacrifice of earning capacity in other forms of investment, interest on the money locked up in land, plant, and equipment is properly an economic charge on the enterprise. The charge is determined by the going rate of return for investments of equivalent risk. Here the buildings and equipment stand as security. An annual charge of 3 per cent on the original investment is equivalent to 5-6 per cent on the undepreciated balance.[1]

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[1] Sammet, L. L., and I. F. Davis, Building and Equipment Costs, Apple and Pear Packing (Berkeley: University of California, College of Agriculture, Agricultural Experiment Station, December, 1952), p. 21. (Giannini Foundation Mimeographed Report No. 141.) Processed. (The fifth report in a series on Efficiency in Fruit Marketing.)

TABLE 7

Depreciation Rates for Buildings and Equipment for Turkey Processing Plants

Item	Economic use life	Rate of depreciation (straight-line basis)
	years	per cent
Concrete and/or metal buildings[a]	40	2.5
Conveyors, troughs, tables, washers, boiler, fork-lift trucks and pallets,[b] weighing and adding equipment	10	10.0
Specialized scalding, picking, eviscerating, and packaging machinery, icing equipment, racks, and truck coops	4	25.0

a/ Sammet, L. L., and I. F. Davis, Building and Equipment Costs, Apple and Pear Packing (Berkeley: University of California, College of Agriculture, Agricultural Experiment Station, December, 1952), 67p. (Giannini Foundation Mimeographed Report No. 141.) Processed. (The fifth report in a series on Efficiency in Fruit Marketing.)

b/ Yale and Towne Manufacturing Co., San Francisco, claims a use life of 15 years but advocates a depreciation rate of 10 per cent.

Insurance.--The cost of insurance is estimated at 0.6 per cent of the new replacement value. This is a typical base insurance rate for concrete or metal buildings located outside a city. Increased charges on property beyond the protection of city fire services are balanced against penalties for proximity to adjacent structures. Equipment incurs the same rate as the building in which it is housed.[1]

Taxes.--Turkey processors pay taxes under several headings. Income taxes are levied on profits or net income and cannot be considered a cost of processing. Taxes levied on employers as part of a social security or unemployment relief program properly amount to an increase in the cost of labor. Their incidence is based on the payroll. In this study, wage payments are adjusted to

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[1] Loc. cit.

include such taxes. Real property taxes levied on the land, buildings, and equipment held for use in the business of processing are true fixed costs. Since these taxes are local in origin, the rate and effective basis of assessment may vary between comparable plants situated in different areas. A standard rate, 1 per cent of the replacement value, is employed.

Repairs.--Repairs and maintenance burdens are not fixed costs in essence. Large expenditures may be incurred on occasion as a result of a particular breakage and nothing subsequently for some time. However, the discrete character of this type of expense item and the relatively short season of the turkey processing industry make it convenient to assess charges for repairs on an annual basis. Heavy repair costs in any one year may generally be avoided by a policy of continuous attention. Repairs will be assessed at 2 per cent of the replacement value of concrete or metal buildings, 3 per cent for equipment.

Tables 8 and 9 summarize the annual total fixed charges under the various headings. On land and buildings interest is the largest single item. The interest charge on the semiscald evisceration model D exceeds $4,000 per year. Total fixed land and building costs for subscald evisceration plants range from $750 for the smallest to $11,750 on the largest.

Fixed charges on the working equipment of the plant are substantially higher. Sharp depreciation allowances are the most influential factor, constituting some two thirds of the fixed charge burden. Overhead costs on equipment in the subscald evisceration plants range between $1,188 on a farm scale and $34,546. Subscald and semiscald evisceration plants incur much the same equipment overheads; those of a New York dressing plant would be substantially less.

United fixed costs may be approached realistically in terms of total output over the period for which the overheads are fixed. Table 10 indicates the effect of season length on the burden of plant and equipment overheads carried by the model plants under the different techniques.1/ The total cost for the year is allocated to each day's output over theoretical seasons ranging from 10-140 days of operation at capacity. The daily charge falls sharply initially with each extension of the season. Beyond 40 days the addition of more days has relatively less effect, but the absolute saving may, nevertheless, make the difference between profit and loss in a sharply competitive environment.

Operators of processing plants are interested in the relationship between the number of days operated per season and the unit level of fixed plant overheads under different techniques. Table 11 shows the estimated cost per turkey

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1/ Overtime work has the same effect on fixed costs as extending the season.

TABLE 8

Fixed Charges on Land and Buildings for Turkey Processing Plants, 1953

	Replacement value			Annual fixed charges					
				Buildings		Land, buildings			
Plant	Land	Buildings	Land, buildings	Depreciation at 2.5 per cent	Insurance at 0.6 per cent	Interest at 3.0 per cent	Taxes at 1.0 per cent	Repairs at 2.0 per cent	Total annual fixed charges
	dollars								
Subscald evisceration									
A	75	8,200	8,275	205	49	248	83	166	751
B	500	47,200	47,700	1,180	283	1,431	477	954	4,325
C	1,750	70,900	72,650	1,772	425	2,180	727	1,453	6,557
D	2,625	127,400	130,025	3,185	764	3,901	1,300	2,600	11,750
Semiscald evisceration									
A	75	8,800	8,875	220	53	266	89	177	805
B	500	54,700	55,200	1,368	328	1,656	552	1,104	5,008
C	1,750	83,600	85,350	2,090	502	2,560	853	1,707	7,712
D	2,625	145,700	148,325	3,642	875	4,449	1,483	2,966	13,415

TABLE 9

Fixed Charges on Processing Equipment for Turkey Processing Plants, 1953

Plant	Replacement value of equipment	Annual fixed charges					Total annual fixed charges
		Depreciation at 10-25 per cent	Interest at 3.0 per cent	Taxes at 1.0 per cent	Insurance at 0.6 per cent	Repairs at 3.0 per cent	
	dollars						
Subscald evisceration							
A	4,150	873	124	42	25	124	1,188
B	50,020	8,773	1,501	500	300	1,501	12,575
C	72,596	12,127	2,178	726	436	2,178	17,645
D	141,252	23,812	4,237	1,413	847	4,237	34,546
Semiscald evisceration							
A	4,150	873	124	42	25	124	1,188
B	50,670	8,896	1,520	507	304	1,520	12,747
C	73,376	12,520	2,201	733	440	2,201	18,095
D	142,812	24,598	4,284	1,428	857	4,284	35,451

TABLE 10

Fixed Plant and Equipment Costs Per Day in Relation to Season Length for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
	dollars annually			
Subscald evisceration				
Plant	751.00	4,325.00	6,557.00	11,750.00
Equipment	1,188.00	12,575.00	17,645.00	34,546.00
Total	1,939.00	16,900.00	24,202.00	46,296.00
	dollars per day			
Days of operation				
10	193.90	1,690.00	2,420.20	4,629.60
20	96.95	845.00	1,210.10	2,314.80
40	48.48	422.50	605.05	1,157.40
60	32.32	281.67	403.37	771.60
80	24.24	211.25	302.53	578.70
100	19.39	169.00	242.02	462.96
120	16.16	140.83	201.68	385.80
140	13.85	120.71	172.87	330.69
	dollars annually			
Semiscald evisceration				
Plant	805.00	5,008.00	7,712.00	13,415.00
Equipment	1,188.00	12,747.00	18,095.00	35,451.00
Total	1,993.00	17,755.00	25,807.00	48,830.00
	dollars per day			
Days of operation				
10	199.30	1,775.50	2,580.70	4,883.00
20	99.65	887.75	1,290.35	2,441.50
40	49.83	443.88	645.18	1,220.75
60	33.22	295.92	430.12	813.83
80	24.91	221.94	322.59	610.38
100	19.93	177.55	258.07	488.30
120	16.61	147.96	215.06	406.92
140	14.24	126.82	184.34	348.79

TABLE 11

Unit Fixed Plant and Equipment Costs in Relation to Season Length for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
	cents per turkey			
Subscald evisceration				
Days of operation				
10	46.16	80.47	57.61	55.11
20	23.08	40.23	28.81	27.56
40	11.54	20.12	14.41	13.78
60	7.69	13.41	9.60	9.19
80	5.77	10.06	7.20	6.89
100	4.62	8.05	5.76	5.51
120	3.84	6.70	4.80	4.59
140	3.30	5.75	4.11	3.94
Semiscald evisceration				
Days of operation				
10	47.45	84.55	61.44	58.13
20	23.73	42.27	30.72	29.06
40	11.86	21.13	15.36	14.53
60	7.91	14.09	10.24	9.69
80	5.93	10.57	7.68	7.27
100	4.75	8.45	6.14	5.81
120	3.95	7.04	5.12	4.84
140	3.39	6.03	4.39	4.15

of operating in four alternative plant sizes at eight different lengths of season.

Figure 6 portrays the behavior of unit fixed subscald plant costs by continuous curves. Plant A operates at the lowest fixed costs under all conditions but may be expected to incur substantially higher variable costs than the others. It is the plant in which there has been least substitution of machinery for human labor. Plant B is higher than C and D at all stages. It is apparent that the equipment and machinery designed for the poultry processing industry gives greater returns for cost at the larger plant sizes.

Administrative Staff

Administrative expenses constitute an important element in the business operation of a turkey processing plant. The critical feature is that relatively highly paid personnel must be maintained throughout the year whether the plant is in operation or not. Staff of the caliber needed to manage a complicated plant and handle the labor problems involved cannot be obtained regularly on a seasonal basis.

All the California plants studied, except the farm operations, maintained a nucleus of managerial and supervisory staff throughout the year, partly to retain key workers in their employment, partly to maintain the plant in readiness for efficient operation when the season opened. Local labor conditions determine the weight of the former motivation. Where the necessary workers have other seasonal employment available on a time cycle that complements that of the turkey industry, the processors' obligations are lighter. If the alternatives are permanent jobs elsewhere or complete unemployment, the turkey plant may be compelled to hold on its payroll a strong enough nucleus to guarantee efficient operation when the season begins. The larger concerns also maintain permanent office help. To this extent the administrative burden may be regarded as an overhead cost related only indirectly to the amount of business handled.

Assessment of the managerial, supervisory, and office requirements for different sized processing plants by direct observation was complicated by major divergences in structure. Three main categories of plant were observed: those owned and operated by a single local entrepreneur, branches of large corporations allowing varying degrees of autonomy to a local manager, and producer cooperatives. Owner-operated plants maintained the simplest administration and the minimum staff outside the operating season. The branch plants of large organizations had substantial managerial and office staffs, but the proportion of

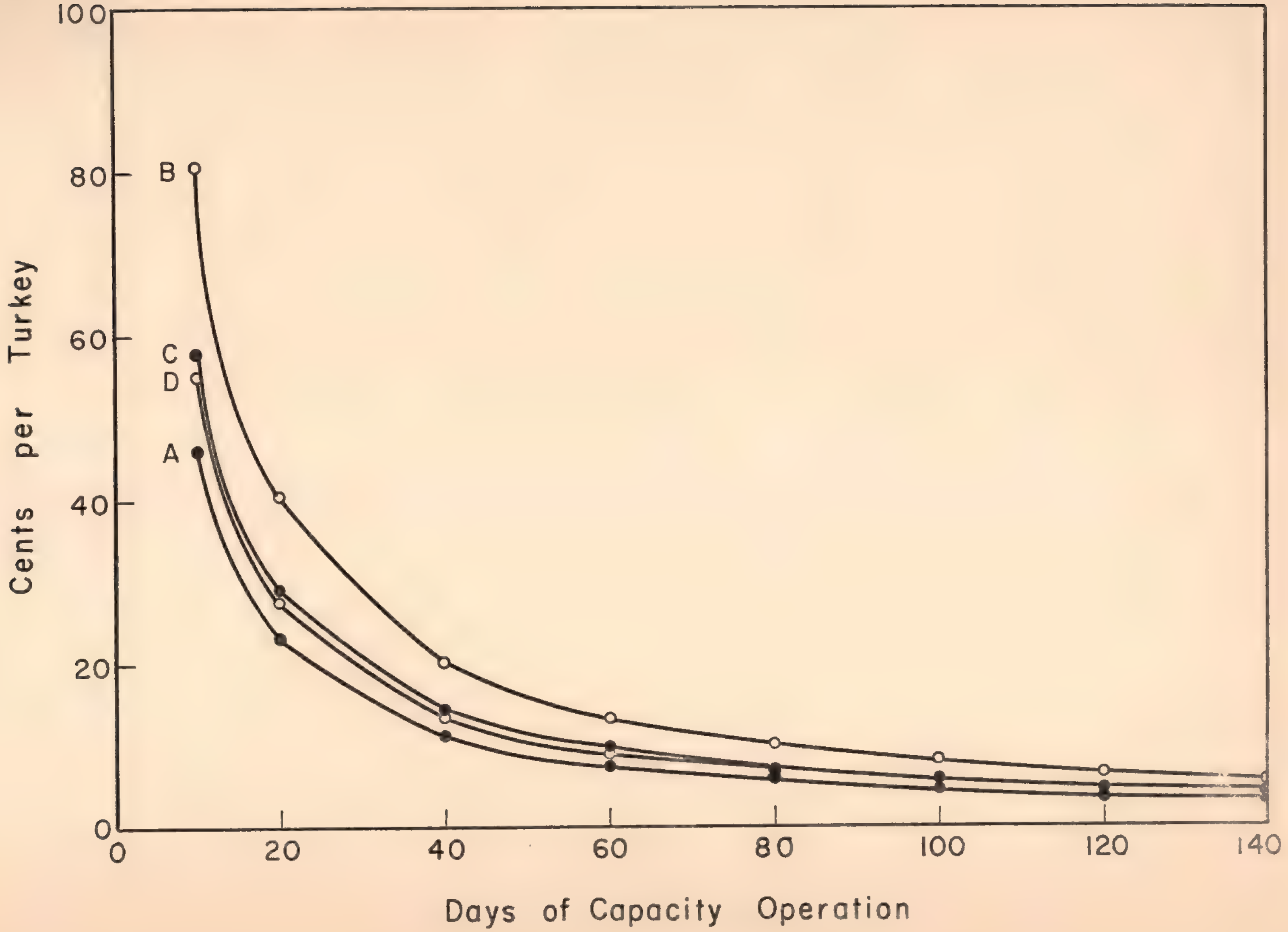

FIGURE 6

Fixed Plant and Equipment Costs in Relation to Scale of Plant and Length of Season: Standardized Subscald Turkey Plants

total cost borne by their turkey processing operations was not clear. Frequently, other processing and marketing responsibilities were consolidated under the same branch management. At the same time, the central administration would also be supported in part by each local branch.

The cooperatives incurred heavier office work burdens than the private enterprise plants because of pool-pricing devices, deferred payments, and the maintenance of members' individual lot identities after processing. They appeared to maintain larger permanent staffs than other processors. However, part of their work may be attributed to cooperative organization and other activities. Since individual salaries might be lower in cooperatives, the total managerial burden on the turkey operation may be no higher than in other plants.

Administrative staff requirements in eviscerating plants are necessarily larger than where only dressing is performed since the number of workers is doubled and the work demands close supervision. Administrative duties may be simplified in subscald plants by the absence of the large picking crews. On the other hand, close control over each processing phase including quick freezing is mandatory if the subscalded produce is to maintain an attractive appearance. No critical basis for differentiation in administrative requirements between these two methods could be derived from the plants studied.

In this study it will be assumed that all supervisory posts down to the level of working foreman involve annual employment. Customarily, foremen and managers undertake maintenance work in the off season. All other labor is treated as variable.

Precise information on administrative salaries was obtained only from a limited number of plants. The costs shown in Table 12 are based on author's estimates and published wage scales (foremen and office staff).

The daily administrative and office salary allowances shown in Table 12 refer to the operational requirements of the processing activity.1/ They cover the responsibility for the inflow and outflow of the product and adjustment of labor, machinery, and supplies to the work in hand. Detailed marketing arrangements are not covered and would be handled by a sales department.

In plant A all administrative responsibilities are handled by the owner, who was included in the variable labor as a working foreman. Planning and office work for the processing plant undoubtedly take up additional time, but estimation of the cost is impracticable. No out-of-season overhead allowance is made for the operator of plant A under the assumption that he would turn to other interests.

1/ For administrative staff allocations, see Appendix Table II.

TABLE 12

Administrative Salary Costs Per Day for
Turkey Processing Plants, 1953

	Plant		
	B	C	D
Turkeys per hour	300	600	1,200
Turkeys per day	2,100	4,200	8,400
	dollars annually		
Subscald and semiscald evisceration			
Total administrative salaries	9,500	20,000	33,500
	dollars per day		
Day of operation			
10	950	2,000	3,350
20	475	1,000	1,675
40	238	500	838
60	158	333	558
80	119	250	419
100	95	200	335
120	79	166	279
140	68	143	239

The small commercial subscald evisceration plants employed a manager and foreman capable of handling engineering adjustments and one office girl. The forewomen over the evisceration girls and picking crews have been included as variable labor.

Evisceration plants on scale C employed a plant superintendent as well as a higher paid manager and a foreman. A full-time bookkeeper and girl assistant comprised the office staff.

Size D plants employing double the labor of plant C at capacity achieved some economy at the administrative level. Manager and superintendent undertook the responsibility of both lines with the aid of specialized dressing and evisceration foreman and increased office staff.

Variable Costs

Labor.--Most labor costs in processing turkeys under contemporary conditions may be classed as variable. Traditionally, picking crews are paid in

strict relation to the number of birds handled. The majority of the production-line workers are employed on an hourly wage basis. The processor may offer work at his discretion, subject to legal regulations on rest periods for women and local labor union agreements. In central California the unionized plants may call in and dismiss a crew at the employers' discretion subject to a minimum work period of four hours.

Data on plant labor requirements were gathered under two headings: actual operation at capacity and operation at the lowest practicable level given the mechanical layout of the plant. In all observational recordings and subsequent discussions with plant managers, a careful distinction was maintained between the staff actually employed and that needed for efficient operation at the rated capacity of the plant. These specifications were set up so that a chance labor situation obtaining at a particular time should not be regarded as normal for given technical procedures. All the labor/output data incorporated in this study reflect the number of work positions that must be filled if a plant is to operate with reasonable efficiency at its normal capacity.

Some processors carried additional workers as trainees or reserves against possible absenteeism. Others switching from one technique to another retained workers experienced under one set of conditions after their particular contribution had ceased to be productive. No allowance is made for overstaffing of this kind although some processors may find it advisable in view of the labor environment in which they operate.

Work Allocations.--Detailed dispositions of labor in the four illustrative modal plants have been set out in Table 13 for subscald and semiscald evisceration, respectively. These labor allocations represent positions that must be filled if the plant is to operate with reasonable efficiency. They are based on data derived from groups of comparable actual plants and adjusted in the light of equipment manufacturers' recommendations and the evident disadvantages or idiosyncrasies of individual plants. Men and women have been specified in various positions in accordance with contemporary practice. Either sex could be employed for many jobs. An important factor in a particular locality may be the wage schedules established by agreement with a labor union.

The detailed disposition of the labor employed in farm plant A could not be shown in Table 13 because it cuts across the job descriptions derived from the conveyor plants. Birds are moved by hand between flexible work stations. Most tasks are performed while the bird is suspended from a fixed shackle or held over a table or trough. In consequence, the various detailed tasks may be combined into different groups and performed in varying sequences.

TABLE 13

Disposition of Seasonal Labor for Turkey Processing Plants[a/]

	Plant							
	A		B		C		D	
	Sub-scald	Semi-scald	Sub-scald	Semi-scald	Sub-scald	Semi-scald	Sub-scald	Semi-scald
Turkeys per hour	60		300		600		1,200	
Dress								
Catch and hang	1m	1m	2m	2m	2m	2m	4m	4m
Kill			1m	1m	1m	1m	2m	2m
Scald	½m	½m						
Pick feathers	1½m	1½m 8w	2m	2m 31w	2m	2m 62w	4m	4m 124w
Clean and finish		1w	1m 4w	1m	1m 7w	1m	2m 14w	2m
Take off line			1m	1m	1m	1m	2m	2m
Eviscerate								
Cut legs and rehang	10w	10w	2m	2m	2m	2m	4m	4m
Check pinfeathers			1w	5w	2w	10w	4w	20w
Trim oil sac, open neck			2w	2w	2w	2w	4w	4w
Pull crop, trim neck			2w	2w	3w	3w	6w	6w
Reverse position			1m	1m	1m	1m	2m	2m
Draw entrails			2½w	2½w	5w	5w	10w	10w
Trim for inspector					1w	1w	2w	2w
Clean, prepare giblets			5½w	5½w	11w	11w	22w	22w
Remove lungs			1m	1m	1m	1m	2m	2m
Remove head, neck			2m	2m	2m	2m	4m	4m
Wash and check	1m	1m	2w	2w	3w	3w	6w	6w
Service chilling tanks			3m	3m	5m	5m	10m	10m
Package	b/	b/						
Convey to packaging table			2m	2m	3m	3m	6m	6m
Prepare for packaging			4w	4w	8w	8w	16w	16w
Grade			1m 1w	1m 1w	1m	1m	2m	2m
Weigh, mark weight	2m 8w	2m 8w			2w	2w	4w	4w
Enclose in plastic bag			4w	4w	8w	8w	16w	16w
Prepare cartons			2m	2m	4m	4m	8m	8m
Enclose in cartons			2m	2m	4m	4m	8m	8m
Record output			1w	1w	2w	2w	4w	4w
Convey cartons			1m	1m	1m	1m	2m	2m
Cleaning, maintenance	2w	2w	3m	3m	4m	4m	8m	8m
Forewomen			1w	2w	1w	2w	2w	4w
Total number employed	14	23	57	89	90	154	180	308

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a/ Men denoted by "m," women by "w."

b/ Positions occupied by the same crew in the second part of work shifts divided approximately as follows: dressing and evisceration, 2½ hours; packaging, 1½ hours.

Observation of some five or six plants of this size indicated that subscald evisceration of 60 birds per hour could be carried out efficiently by an average crew of 14. Some ten women work with four men, one of whom is the owner-operator. His part as working supervisor, preparing equipment and supplies, correcting defects and shifting workers between tasks so as to balance the work evenly, is critical for the smooth progress of such an operation. In the mechanized plants, the majority of tasks, once the extent of each worker's responsibility is indicated, are paced by an automatic conveyor. In plant A the rate of operation depends on the development of output standards and the example set by the operator and his family.

Two substantial factors make a shift system the most efficient division of labor in such a plant. First, a practical minimum chilling period for eviscerated turkeys in ice slush is 2½ hours. Thus, packaging may not begin until such an interval has elapsed after the first birds have been eviscerated and entered the chilling tank. Second, the use of a crew large enough to carry on all the necessary operations simultaneously raises problems of personnel and working space in the plant itself. Plant A operators rely on farm production workers, their wives, and neighbors to make up an adequate crew. Such help is needed for a short season only. Better results are obtained with a small staff gathered on such a basis than a large crew drawn from casual seasonal labor reserves.

In a plant operated on these lines, the sequence of work proceeds as follows. Two men catch, kill, pull wing and tail feathers, and attach the bird to the scalding bar. The bird is then moved up and down in the water automatically to insure a thorough scald. A third man takes off the bulk of the feathers with a drum picker. The next worker clips off head and legs. Five more women handle the neck, crop, entrails, giblets, lungs, and oil sac. Four check for pinfeathers, wash the carcass, and trim the legs as a final comprehensive operation. Where there is no mechanical means of transferring the bird from one worker to another, one woman carries out a sequence of operations with a single bird instead of specializing on one task.

When all the chilling tank capacity is occupied, killing ceases. The whole crew is switched to a second combination of tasks. Chilled birds are hung on racks to drain and the plant readied for packaging. The same crew of 14 is able to grade and weigh the birds, fit on and shrink the plastic bags, prepare and close boxes, dispose of the finished produce and waste material, and wash down the plant and equipment so as to permit an over-all rate of 60 birds per hour. Where the same operation is repeated in the afternoon, part of the dressing team may be diverted to catching another load of live birds.

Semiscald operations in plant A involve the use of additional pickers and checkers to finish birds after the mechanical picker. Customarily, such work is handled on a piece-rate basis. Payment is based on the number of turkeys picked by each member of the crew. Thus, the operator is not responsible for waiting time. The number of pickers is not important provided that their overall pace is adjusted to the rate of turkeys coming from the killing, scalding, and buffing team. Under the two-shift system, they would be required for some $2\frac{1}{2}$ hours in the morning and afternoon. Synchronization of operations to obtain proper chilling and draining while employing the available labor to the best advantage is the main problem in such plants.

Traditional New York dressing procedures permitted completion of the day's output in one shift while a full crew was present. Cooling took place overnight in a dry-air refrigerated compartment. The work of wrapping heads in parchment, transferring birds to the cooler, and moving out the previous day's load was carried on by the basic staff after the pickers left.

Automatic Conveyor Plants.--In plants B, C, and D, the labor allocation is determined in great part by the need to service automatic equipment and a conveyor belt system at given positions. B represents the lower capacity range of a fully mechanized processing plant according to 1953 standards. C reflects the higher range. D incorporates two plant C lines with no additional replacement of labor by machinery.

Labor use study among the plants in the B and C size ranges indicated that many of the smaller capacity units had to employ men in positions where they were underworked as compared with larger plants.

It appeared that, given a piece-rate incentive, a hanging and killing crew of three as used in a 300-per-hour plant could achieve a rate of 600 per hour without loss of efficiency. At all rates of operation, each conveyor dressing system employed one man to extract wing and tail feathers before the bird entered the scalder and a second to evacuate the vent. Similarly, all plants employed one man stationed at a mechanical quill puller. Localized, isolated tasks generally show relative diseconomies in labor use at the slower rate of operation. The staff engaged in taking birds off one line and hanging on another, changing the position of the bird for convenient drawing, and controlling washing points, cutting off head and neck, and operating a lung puller is the same size whether the rate is 300 or 600 turkeys per hour.

Although the labor units are not divisible, a second category of necessary operations can be distributed between workers in different proportions. Under

current technological conditions, the various elements of evisceration--opening the bird for removal of crop and entrails, trimming and checking the carcass and edible giblets--are susceptible to breakdown among variable numbers of workers. A second crop puller, for example, may ease the load of a neck trimmer.

A third category of operations is related only indirectly to the conveyor belt and dependent almost entirely on human effort. Hand servicing of the chilling tanks, packaging operations, and box-closing sequences seem to require increasing the labor unit input proportionately with the amount of product handled.

All the evisceration plants submitted their products to inspection by duly authorized U. S. Department of Agriculture representatives. Inspection takes place at the stage when the entrails have been drawn out but are still attached to the bird. Diseased or damaged birds may be condemned in entirety or in part. Since the inspector may stop the conveyor while he cuts away a condemned part, the larger plants station a helper at his side to minimize the delay.

Quality grading was the general practice in the plants studied; consequently, all the standardized models provide for a grader at the weighing and packaging stage. The preferred method of indicating the grade is to lay on the bird a distinguishing tab or the appropriately marked plastic bag. The grades are then boxed separately.

Boxing techniques appeared to be comparable in all plants. Workers either assemble ready-wired wooden boxes or staple together fibreboard cartons with a stapling machine. Labor provision in the subscald plants is based on in-plant assembly and the use of 100-pound wooden boxes or telescope-lid, four-turkey-capacity cartons. Smaller cartons involve additional labor assembling, fitting, closing, and marking.

The labor disposition in Table 13 carries the product to the stage of packed-box transfer. One man is provided to move full boxes into a freezer or load them out onto a vehicle according to whether they are stored at the plant or elsewhere. In plant B a hand-lift truck is used, in plant C an electric power-lift truck. Day and night cleaners are required for feather and offal disposal, washing down the plant, etc. One forewoman working on the same basis as the seasonal crew is employed with each eviscerating or semiscald picking line.

A picking crew and additional pinners are required with the lower temperature scald. Picking labor has been allocated on a basis of one woman per ten turkeys per hour, the average performance in six plants employing such crews. Since payment is made on a piecework basis, dependable inspectors are required to check their work, one in B, two in C.

The construction of plant D (1,200 turkeys per hour) is founded on a narrower observation base than A, B, and C. Study of plants operating at such a rate revealed no significant progress in intensifying the processing operation. Their high rates of output were obtained by operating two parallel production lines each identical with C. Accordingly, plant D has been constructed on these lines. Plant operators declared that labor requirements were doubled from the live hanging point to disposal of the packaged product. Labor allocations in plant D follow this principle, but the requirements of flexible tasks such as carton preparation and cleaning are probably overstated.

Wage rates.--Apart from certain key positions, processing workers may be classed as semiskilled and unskilled according to the degree of training needed to carry out their tasks at the appropriate level of speed and accuracy. Jobs involving manipulative accuracy and specialized equipment are treated as semiskilled. Feather picking, washing, and cleaning tasks are regarded as unskilled. Further distinctions are drawn between dependable, experience workers, and newcomers in the same task. Higher rates are paid to a proportion of key personnel of this type. In general, however, the trend has pointed toward a narrowing of the range of pay within a plant. The difference between the foreman's and the average worker's pay has almost lost its significance.

Some differences in wage levels were noted between plants in accordance with union pressure and local competition for labor. The large plants situated in the main area of concentration seemed to observe a standard scale which had been negotiated by labor union action. Rates for each recognized task were established according to a detailed schedule and posted publicly in each plant. These rates apply to the bulk of the productive capacity of the industry. They will be used in this study under the title rate I.

Smaller concerns and plants located in other areas did not necessarily observe the same scale. Short-season operators in small towns and farm areas obtained adequate labor at substantially lower hourly rates. An average of the rates paid under such conditions was prepared under the title rate II.1/

Rates I and II do not necessary show the same differential at all positions. Some jobs, such as the manual picker operator, are of great strategic importance to the small processor but less significant in a large plant where automatic pickers do most of the work. Whereas rate II might be applicable to plants A and B according to location, it would not be found in plants on the scale of C

1/ For details of Rates I and II, see Appendix Table III.

and D. Labor costs will be assessed for plants A and B, therefore, on both scales, for C and D on rate I only. The actual wage structure has been simplified by grouping subcategories under a few major headings; however, the essential relationships obtaining during the 1953 season have been maintained.

Other Labor Costs.--Employers must expect to meet additional charges in considering the actual cost of most types of labor. In addition to the agreed wage rate, the employment of labor involves social security contributions, workmen's compensation insurance premiums, and unemployment taxes. Subject to detailed conditions of eligibility, duration of employment, etc., these charges bear a standard relationship to the wage rate: unemployment taxes amount to 3 per cent and social security contributions, 1½ per cent (2 per cent from January 1, 1954). Workmen's compensation insurance premiums for production workers may be estimated at 1-3/4 per cent. Though employers of casual workers would not incur such charges on their whole labor force, coverage is extending. Total wage charges to the standardized plants will be augmented by 6 per cent to reflect these employer contributions.

Table 14 sets out the estimated labor cost of operation under each technique. Hourly wages are summed for an eight-hour day.1/ Piece-rate wages are based on a normal day's work estimated as seven hours' operation at capacity under the given conditions. The total constitutes the cost of labor per day. The average labor cost per bird is then computed for each plant according to the technique employed.

Figure 7 shows the relative difference in labor costs between the two scalding techniques for plants of increasing capacity. The saving is approximately 20 cents per turkey in all cases. At standardized wage rates the average labor cost per bird diminishes as the scale of plant increases from A through C. Plant D operates on the same labor cost basis as C as might be expected since there were no major technical differences.

The compensating effect of differences in wage rates is brought out well in Figure 7. Under semiscald techniques plant B can bring its labor costs down to those of C and D by engaging labor at lower rates. With this advantage, it can compete on labor costs, a major expense item. It may be presumed that differences in wage rates have been a major factor in maintaining competition by such plants. A general switch to subscald operations would tend to reduce the effect of such differentials. Clearly, farm operators benefit from lower wage

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1/ Higher wage rates are applicable where overtime is employed.

TABLE 14

Cost of Labor for Turkey Processing Plants, 1953

	Plant					
	A		B		C	D
Turkeys per hour	60		300		600	1,200
Turkeys per day	420		2,100		4,200	8,400
	Wage scale					
	I	II	I	II	I	I
	dollars					
Subscald evisceration						
Time wages per hour	20.69	17.35	83.11	72.75	124.59	249.18
Time wages per day	165.52	138.80	664.88	582.00	996.72	1,993.44
Piece-rate wages per day	--	--	--	--	73.50	147.00
Total wages per day	165.52	138.80	664.88	582.00	1,070.22	2,140.44
Employer payments	9.93	8.33	39.89	34.92	64.21	128.43
Total labor cost per day	175.45	147.13	704.77	616.92	1,134.43	2,268.87
Total labor cost per turkey	0.4177	0.3503	0.3356	0.2938	0.2701	0.2701
Semiscald evisceration						
Time wages per hour	22.36	18.85	86.25	75.60	130.57	261.14
Time wages per day	178.88	150.80	690.00	604.80	1,044.56	2,089.12
Piece-rate wages per day	73.50	65.10	367.50	325.50	808.50	1,617.00
Total wages per day	252.38	215.90	1,057.50	930.30	1,853.06	3,706.12
Employer payments	15.14	12.95	63.45	56.37	111.18	222.37
Total labor cost per day	267.52	228.85	1,120.95	986.67	1,964.24	3,928.49
Total labor cost per turkey	0.6370	0.5449	0.5338	0.4698	0.4677	0.4677

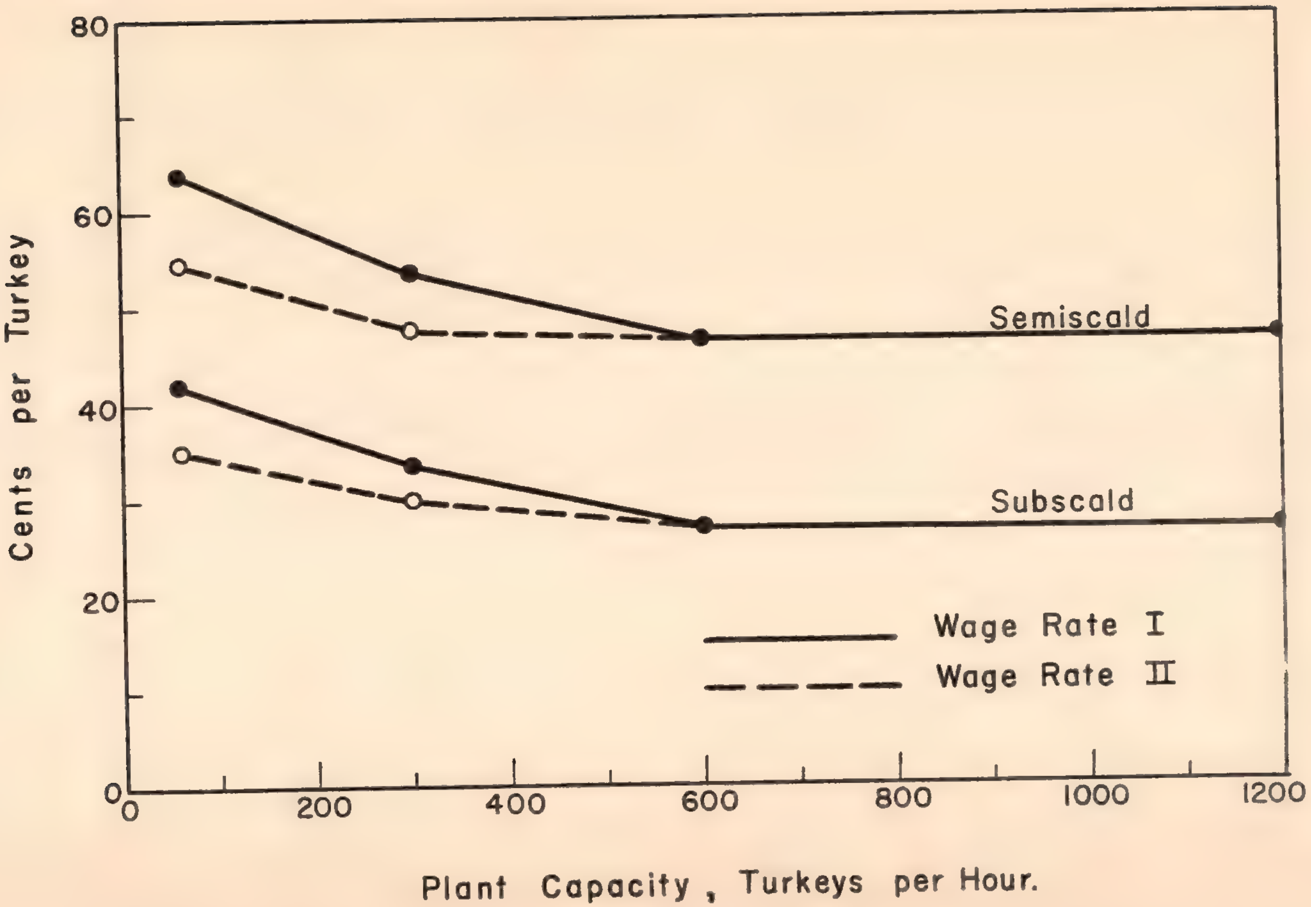

FIGURE 7

Labor Costs in Relation to Scale of Plant and Level of Wages:
Standardized Subscald and Semiscald Turkey Plants

scales to the same or an even greater extent and will be affected in the same way by a general adoption of subscald procedures.

Power and Light.--Electrical power is employed in turkey processing plants as a source of light and automotive power. For heating purposes gas or oil is preferred. Total costs for electricity were distinguished in observational plants, but few were able to relate these charges to the specific tasks performed. Accordingly, electricity charges have been computed on an expected load basis determined by the rated horsepower of each motor in the plant, the customary power consumption rating for its size, and the number of hours in operation.

The unit price of electricity in California reflects domestic, agricultural, commercial, and industrial classifications as to use and also the total quantity consumed. The rate per unit falls sharply as consumption increases except where this factor is balanced by charges levied on horsepower capacity. Under most schedules, consumption is metered on a monthly basis. Operating near capacity, plants B, C, and D could obtain electrical service at rates between 2.1 and 2.6 cents per kilowatt-hour. Plant A could keep its effective rates on a comparable basis only if its power could be drawn through the meter serving the residence of the operator. Motor size would also be restricted to single phase capacity (5 h.p. approximately); thus, it could operate on the domestic schedule and bring its average rate down to 2.0-2.30 cents per kilowatt-hours. Intermittent operation outside the peak season would incur rates up to 5 cents per kilowatt-hour. Since the price of electrical power remains a minor element in total processing costs and its significance does not warrant detailed computation, an average rate of 2.5 cents per kilowatt-hours will be assumed.

Table 15 summarizes the power and light charges incurred by turkey processing plants under different conditions. The conveyor and light differential between subscald and semiscald evisceration plants is small. Electricity costs are low in the farm plant because little use is made of mechanical equipment. Plant B has high power costs because the installed horsepower approaches that of C, while the output of product is only half as large. Since most pieces of processing equipment are driven by individual motors, duplication of the C line in plant D virtually doubles the power requirement.

Heat.--In the larger plants, a central boiler system supplies steam to all parts of the building for heating, scalding, and cleaning uses. Fuel for the boiler furnace is the main direct cost item. The cheapest fuel in California, and that used in most establishments surveyed, is natural gas.

TABLE 15

Power and Light Costs for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
Subscald evisceration				
Kilowatt-hours electricity per hour	5.3	65.8	82.2	159.6
Kilowatt-hours electricity per day	42.4	526.4	657.6	1,276.8
	dollars			
Cost per day	1.06	13.16	16.43	31.92
Cost per turkey	0.252	0.627	0.391	0.380
Semiscald evisceration				
Kilowatt-hours electricity per hour	5.7	67.6	85.5	166.2
Kilowatt-hour electricity per day	45.6	540.8	684.0	1,339.6
	dollars			
Cost per day	1.14	13.52	17.10	33.90
Cost per turkey	0.271	0.644	0.407	0.404

Plants without economic access to gas lines of the correct pressure may substitute oil, electricity, or liquified petroleum gases. Oil fuel is competitive with natural gas pricewise, but oil furnaces involve more elaborate equipment and maintenance than gas or electric burners. Scalding and dipping tanks designed for small plants are equipped by the manufacturers with individual electric or gas heaters. Liquified petroleum gas was the preferred fuel among observed plants of this size.[1] Propane truck service is available at all farm locations. The gas is stored in a container leased by the distributor. It is assumed that the storage leasing charge is amortized over a five-year period and is shared equally with brooding and other uses. Fuel requirements are estimated on a monthly basis since the effective unit price of the fuel is related to the monthly rate of consumption.

In Table 16 heating costs have been calculated for plants B, C, and D in terms of the general natural gas service and for plant A in terms of propane. The estimate for 20 days' operation per month is used in assessing total costs.

Water.--Adequate supplies of clean water are needed in all slaughtering enterprises. Poultry evisceration plants use it for scalding and cooling, automatic spray and hose type washers, and the production of steam. In New York dressing plants water was needed primarily for scalding and cleaning. The use of mist sprays in subscald plants to limit discoloration by dehydration during the course of processing might result in a greater consumption of water than semiscald procedures. The difference in cost would be hardly significant.

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[1] The cost of heating scalder and shrinking tanks rated by the manufacturers as requiring the output of 9 kilowatt-hours electric burners may be compared for various types of fuel and supply prices.

Fuel							
Electricity		Propane		Natural gas		Oil	
Unit price	Cost of heat	Unit price	Cost of heat	Unit price	Cost of heat	Unit price	Cost of heat
cents per kilowatt-hour	cents per hour	cents per gallon	cents per hour	cents per cubic foot (1,000 B.T.U.)	cents per hour	cents per gallon	cents per hour
2.5	22.5	17.93	5.98	0.045	1.38	14.0	3.07
1.2	10.8	16.46	5.49				
0.8	7.2	16.16	5.39				
		12.00	4.01				

TABLE 16

Heating Costs for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
Subscald and semi-scald evisceration	Propane gallons	Natural gas cubic feet (1,000 B.T.U.)		
Daily consumption	4.45	9,600	16,000	25,600
Heating cost per day:	dollars			
Days of operation				
5	1.46	4.88	7.75	12.03
10	1.05	4.59	7.43	11.68
20	0.93	4.42	7.26	11.01
Heating cost per turkey:				
Days of operation				
5	0.348	0.232	0.184	0.143
10	0.250	0.218	0.177	0.139
20	0.221	0.210	0.173	0.131

Accurate estimation of water consumption rates in all the observation plants proved impracticable. Meters are read at monthly intervals. Correlation with processing operations in one evisceration and one dressing plant gave average monthly water use rates of 8 gallons and 4.75 gallons per turkey, respectively. Since these plants were employing equipment comparable to that of plants B, C, and D, the above rates will be applied provisionally. The rate of water use in plant A where birds are washed by hand dipping would depend on how frequently the water is changed.

Charges by public bodies supplying water decrease sharply with increases in the volume consumed per month. The rates given in Table 17 start at 12 cents per 100 cubic feet, declining to 7 cents at levels exceeding 50,000 cubic feet per month.

Ice.--Regular supplies of ice are essential for all eviscerating plants using the water-chilling method. The body temperature is reduced from 90°-100° F. to 40° F. by immersion in tanks of ice and water for periods up to four hours. The customary rate of use of ice was stated as one pound per pound of turkey (eviscerated weight) in all plants chilling thoroughly before packaging.

TABLE 17

Water Costs for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
Subscald and semiscald evisceration				
Gallons of daily consumption	1,680[a]	16,800	33,000	67,200
Cubic feet of monthly consumption[b]	4,894	49,409	99,818	197,635
	dollars			
Cost of water per month	4.89	43.59	78.87	147.34
Cost of water per day	0.22	1.98	3.58	6.70
Cost of water per turkey	0.052	0.094	0.085	0.080

a/ Estimated at 50 per cent of rate found in automatic washing plants.

b/ Assuming 22 working days.

None of the observed plants manufactured their own ice. The general policy was to have loads of ice delivered daily from the nearest specialized ice plant, either in the form of blocks for crushing or as flake ice for immediate use. The price paid for ice varied widely according to the locality of the processor, the delivery distance from nearest ice plant, and the quantity of ice purchased.[1] Delivery charges diminish where half the cost of the journey may be charged to transportation of packed turkeys to the same ice company for freezing. Clearly, processing plants were best located with respect to these critical features of an eviscerating operation when adjacent to a freezing plant able to serve their needs. The prices given in Table 18 take into account expected allowances for

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[1] Ranging from $4.50-$7.00 per ton according to information furnished by the National Ice and Cold Storage Co., San Francisco. An outlying farm processor was charged as much as $20.00 per ton for small quantities delivered daily.

size of order and distance of transportation. The small outlying processor incurs a severe differential cost burden.

TABLE 18

Cost of Ice for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
Subscald and semi-scald evisceration	pounds			
Ice required per day	7,500	37,800	75,000	150,000
	dollars			
Delivered price per 100 pounds	0.75	0.30	0.25	0.25
Cost of ice per day	56.70	113.40	189.00	378.00
Cost of ice per turkey	13.50	5.40	4.50	4.50

Installation of an ice-making unit in the processing plant offers an alternative source of supply. Concern over the high cost of ice under the slush chilling method has provoked some interest in the relative advantages of outside purchase and in-plant manufacture. In Figure 8 cost estimates supplied by a manufacturer of ice-making units have been compared with the prices of custom-delivered ice as reported by the smaller plants in California. The direct costs of water and electricity are relatively low. Overhead charges on the installed ice maker, compressor, motor, and fittings are substantial over a limited turkey processing season.[2]

The installations considered in Figure 8 would produce ice automatically over a 24-hour period at a rate adequate to the requirements of plants A and B operating on a normal eight-hour-day basis. Since the ice is formed in flakes, crushing expenses would be eliminated.

1/ Estimated by author from information supplied by Kent Industries, Inc., Chicago. For details, see Appendix Table IV.

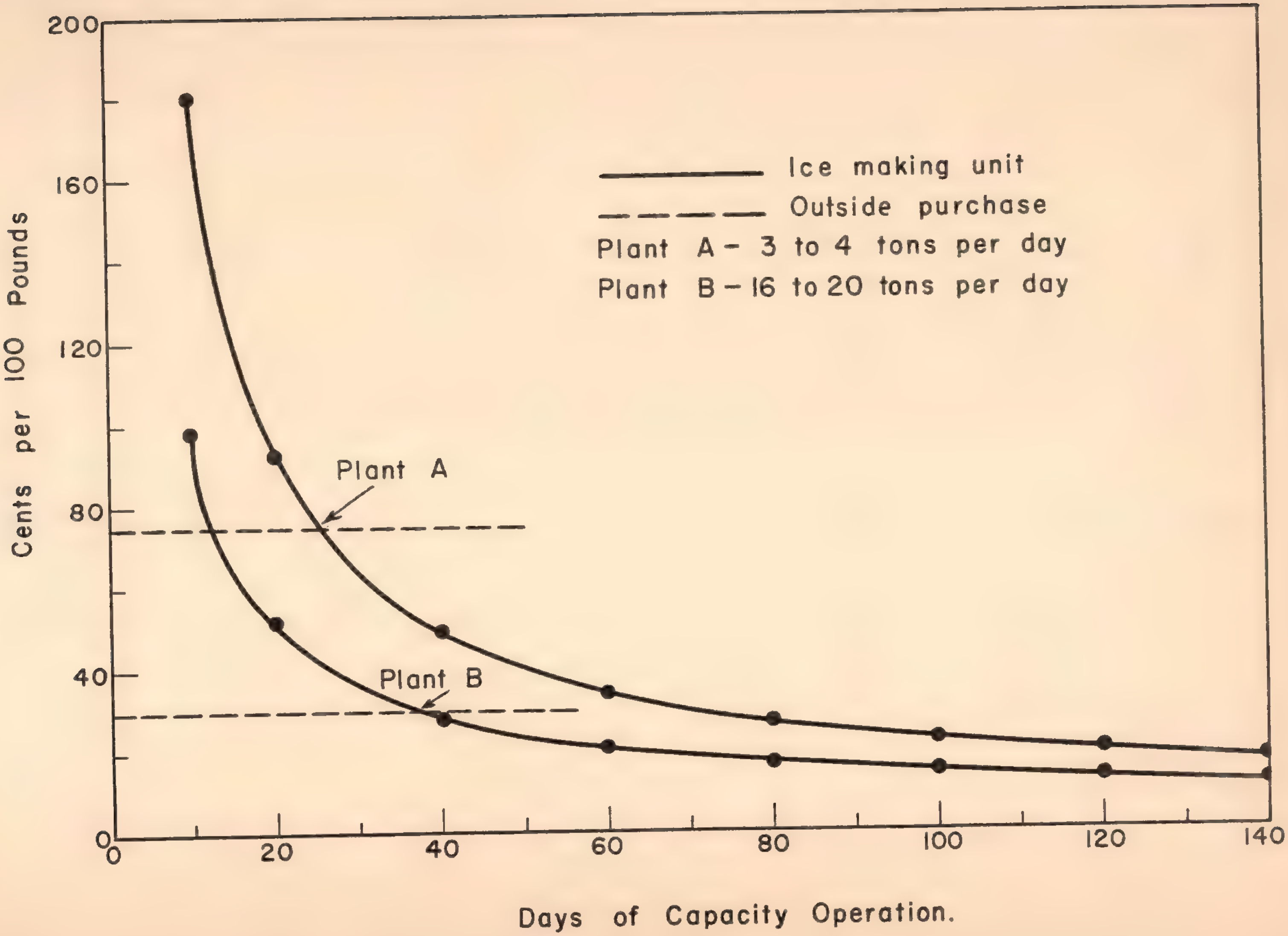

FIGURE 8

Operating Cost of Ice-Making Units in Relation to Scale of Operation and Season Length and Delivered Price of Ice

Costs of producing flake ice by these methods fall sharply with increases in the length of season operated. Plant A would benefit by such an installation provided it operated for at least 26 capacity days per season, plant B would need a season of 38 days or more. The saving applicable to plant A increases rapidly with additional operation. Over a 40-day season it would amount to some 25 cents per 100 pounds, approximately 4.5 cents per turkey. However, the apparent break-even point, 26 days of capacity operation, may fall close to the limit for many size A plants. The potential benefits to B-size operators--6.4 cents per 100 pounds at 50 days and 9.7 cents per 100 pounds at 60 days (1.15 and 1.75 cents per turkey, respectively)--are lower in unit amount but accessible within the expected season for such plants. Comparable estimates for plants of C and D capacity are not presented since ice-making units on the appropriate scale would be custom built to meet their specifications.

Packaging Materials.--Packaging materials required by turkey processing plants include wood or fibreboard boxes, wax-paper liners, individual plastic turkey bags, and paper giblet bags. Boxes are needed both for eviscerated and New York dressed turkeys if they are to be transported any considerable distance. Plastic bags are used only for eviscerated produce, being obligatory for carcasses that have undergone a subscald. Wooden boxes require a wax-paper liner, while New York dressed birds receive no individual packaging beyond the paper head wrapper.

Factors governing the type of box used in turkey processing include the cost, durability in transit, and convenience in freezing and storage. The customary wooden box holds some 5-6 adult birds and weighs approximately 100 pounds full. In fibreboard a wide range of sizes down to single bird cartons is available. However, the smaller sizes carry higher unit costs per bird in initial cost, boxing labor, and storage space. Slatted wooden boxes withstand stacking without crushing and permit rapid freezing through the cracks between slats. Fibreboard cartons have less strength unless reinforced with center partitions. Partitions demand greater attention to size adjustment but protect the plastic bags from freezing together and tearing. Fold-in-top cartons have great strength but also involve more labor and slow down the rate of freezing. Holes through the ends and sides ameliorate this problem at the cost of weakening the structure.

The plastic bag in most general use is that marketed under the trade name "Cry-o-vac," formed of a plastic film that shrinks 25 per cent on contact with hot water or steam. Most firms incurred the additional cost of purchasing plastic bags printed with colored trade names and publicity material. Assuming

similar size policies, costs of packaging supplies differ between plants mainly in accordance with the scale of lot purchased. Most processors obtained bags printed with their own trademarks and distinguished by grade.

The 16" x 27" size is appropriate for large hens and medium-sized toms and thus represents the modal size group. However, a substantial proportion of any processor's output would require smaller or larger bags. Thus, only the largest plants could purchase enough bags in any one lot to obtain the lowest lot prices.

In Table 19 prices for packaging supplies have been charged to each plant on the basis of the lot price most appropriate to its scale of output on a single season basis. It is assumed that competitive market pressure would force all to use the printed plastic bags. The difference in unit cost to the largest and smallest plants amounts to some 30 per cent, that between the three larger plants is less significant.

TABLE 19

Cost of Packaging Supplies for Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
Evisceration	cents per turkey			
Carton	15.16	12.73	12.73	12.73
Giblet bag	0.60	0.60	0.60	0.60
"Cry-o-vac" bag	19.47	14.22	13.77	13.62
Total	35.23	27.55	27.10	26.95
	dollars			
Cost per day	147.97	578.55	1,138.20	2,263.80
Cost per turkey	0.3523	0.2755	0.2710	0.2695

Sources: Estimated from information furnished by Fibreboard Products, Inc., San Francisco; Dewey and Almy Chemical Co., San Leandro, California; Quaker City Paper Co., Philadelphia; and cooperating processors.

The cost of packaging supplies for New York dressed birds was substantially lower. Use of the plain wooden box with paper liner has been standard for a number of years. Stocks could be held over between seasons with minimal risks of obsolescence; thus, small plants would suffer less of a disadvantage in lot purchasing.

Miscellaneous Expenses.--Secondary charges such as telephone, postage, and office supplies and equipment costs are incurred in some measure by all processing enterprises. However, the size of their total contribution to over-all costs did not warrant detailed study. Few of the concerns furnishing accounting data distinguished these items. Some were cooperatives which incur heavier office expenses than comparable private enterprises. Estimates were based on a small number of concerns and the experience of other processing plants. These costs will be treated as variable since they are related to the number of transactions concluded per year. They are relatively low in plant A because the operator draws upon his own flock for the bulk of his supplies.

Estimated Miscellaneous Costs for
Turkey Processing Plants, 1953

	Plant			
	A	B	C	D
	dollars			
Cost per day	2.50	30.00	45.00	60.00

Analysis of Total Costs

The various cost items may now be assembled in totals for analysis in terms of three major considerations. The costs of subscalding and semiscalding turkeys in various types of plants will be set up for detailed comparison. Next, the influence of scale of plant on costs will be assessed for each processing method. Segregation of fixed and variable costs permits accurate estimation of the effect of season length on the total costs of operation in different plants. Finally, the study will be rounded out by the consideration of certain expenses that are not processing costs in the strictest sense but are incurred in the conduct of a processing business and may have great bearing on its economic profitability. Fixed plant, equipment, and administrative overheads may be brought together as total fixed costs per year and related to output units (Table 20) according to the amount of capacity operation per season.

TABLE 20

Total Fixed Plant, Equipment, and Administrative
Costs Per Turkey, Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
	cents per turkey			
Subscald evisceration				
Days of operation				
10	46.16	125.71	105.24	95.00
20	23.08	62.86	52.62	47.50
40	11.54	31.43	26.31	23.75
60	7.69	20.75	17.54	15.83
80	5.77	15.72	13.16	11.88
100	4.62	12.57	10.52	9.50
120	3.84	10.38	8.77	7.92
140	3.30	8.69	7.52	6.78
Semiscald evisceration				
Days of operation				
10	47.45	129.78	109.06	98.01
20	23.73	64.89	54.53	49.00
40	11.86	32.44	27.26	24.50
60	7.91	21.63	18.18	16.33
80	5.93	16.22	13.63	12.25
100	4.75	12.98	10.91	9.80
120	3.95	10.82	9.09	8.16
140	3.39	9.27	7.79	7.00

Variable costs of evisceration per day and per turkey according to scald technique and size of plant are summarized in Table 21. Here, and in all subsequent computations unless otherwise stated, wage rate I is assumed uniformly for all plants.

Subscald, Semiscald Differentials

In Table 22 the major cost items in processing by semiscald and subscald methods are correlated for each type of plant, and the difference is shown. The specific saving is then shown as a percentage of the semiscald cost. Realistic inclusion of overhead costs in such a comparison required that they be related to the output of the period for which they would be priced. The operating seasons assumed in Table 22 approximate the normal length for actual plants of the same type under California conditions.

The saving on labor costs between subscald and semiscald techniques amounts to 34.4 per cent in plant A, 37.2 per cent in B, and 42.3 per cent each in C and D. The reduction in conveyor length and picking space effects a small economy in the consumption of electricity for light and power. However, the saving (1.0-3.7 per cent) is barely significant costwise. Other variable cost items remain unaffected. The difference in fixed costs between the two methods of processing is small, 0.30-0.88 cents per turkey, averaging 3.4 per cent of the semiscald overhead. Undoubtedly, the basis for a change from semiscald to subscald techniques would be founded on the major saving in picking labor, amounting to some 20 cents per turkey in each plant.

Scale of Plant

The differential incidence of direct cost items in relation to scale of plant is also shown in Table 20. Labor costs at the same wage rates are higher in the farm and small commercial plants than in the two largest by 54.6 per cent and 24.2 per cent, respectively. Little gain in labor efficiency is obtained by merely duplicating a type C conveyor system as in plant D.

Utility costs in A were not strictly comparable with the other plants on a basis of scale because little power machinery was employed and washing was effected by hand dipping and rinsing instead of automatic sprays. Heating fuel costs fell steadily as the scale of plant increased. Electrical light and power charges for plant B were almost double those of C since much the same machinery was in operation for an output only half as large.

TABLE 21

Total Variable Costs Per Day and Per Turkey for Processing Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
Turkeys per day	420	2,100	4,200	8,400
	dollars per day			
Subscald evisceration				
Labor	175.45	704.77	1,134.43	2,268.87
Power, light	1.06	13.16	16.43	31.92
Heat	0.93	4.42	7.26	11.01
Water	0.22	1.98	3.58	6.70
Ice	56.70	113.40	189.00	378.00
Packaging materials	147.97	578.55	1,138.20	2,263.80
Miscellaneous	2.50	30.00	45.00	60.00
Total	384.83	1,446.28	2,533.90	5,020.30
Semiscald evisceration				
Labor	267.52	1,120.95	1,964.24	3,928.49
Power, light	1.14	13.52	17.10	33.90
Heat	0.93	4.42	7.26	11.01
Water	0.22	1.98	3.58	6.70
Ice	56.70	113.40	189.00	378.00
Packaging materials	147.97	578.55	1,138.20	2,263.80
Miscellaneous	2.50	30.00	45.00	60.00
Total	476.98	1,862.82	3,364.38	6,681.90
	cents per turkey			
Subscald evisceration				
Labor	41.77	33.56	27.01	27.01
Power, light	0.25	0.63	0.39	0.38
Heat	0.22	0.21	0.17	0.13
Water	0.05	0.09	0.08	0.08
Ice	13.50	5.40	4.50	4.50
Packaging materials	35.23	27.55	27.10	26.95
Miscellaneous	0.60	1.43	1.07	0.71
Total	91.62	68.87	60.32	59.76
Semiscald evisceration				
Labor	63.70	53.38	46.77	46.77
Power, light	0.27	0.64	0.41	0.40
Heat	0.22	0.21	0.17	0.13
Water	0.05	0.09	0.08	0.08
Ice	13.50	5.40	4.50	4.50
Packaging materials	35.23	27.55	27.10	26.95
Miscellaneous	0.60	1.43	1.07	0.71
Total	113.57	88.70	80.01	79.54

TABLE 22

Comparison Subscald and Semiscald Evisceration Costs

Plant	Labor	Utilities	Ice	Packaging materials	Miscellaneous	Overhead[a]	Total
	cents per turkey						
A. Semiscald	63.70	0.54	13.50	35.23	0.60	15.82	129.39
Subscald	41.77	0.52	13.50	35.23	0.60	15.39	107.01
Difference	21.93	0.02	--	--	--	0.43	22.38
B. Semiscald	53.38	0.94	5.40	27.55	1.43	21.63	110.33
Subscald	33.56	0.93	5.40	27.55	1.43	20.75	89.62
Difference	19.82	0.01	--	--	--	0.88	20.71
C. Semiscald	46.77	0.66	4.50	27.10	1.07	10.91	91.01
Subscald	27.01	0.64	4.50	27.10	1.07	10.52	70.84
Difference	19.76	0.02	--	--	--	0.39	20.17
D. Semiscald	46.77	0.61	4.50	26.95	0.71	9.80	89.34
Subscald	27.01	0.59	4.50	26.95	0.71	9.50	69.26
Difference	19.76	0.02	--	--	--	0.30	20.08
Difference as percentage of semiscald cost:							
A	34.43	3.70	--	--	--	2.72	17.30
B	37.13	1.06	--	--	--	4.07	18.77
C	42.25	3.03	--	--	--	3.57	22.16
D	42.25	3.28	--	--	--	3.06	22.48

[a] Unit overhead cost based on operating seasons as follows: A--30 days; B--60 days; and C and D--100 days.

In direct cost items such as ice and packaging materials, where the physical input per bird handled is on the same unit basis in all plants irrespective of size, cost differentials derive from the unit purchase price of the product. As compared with the largest enterprise, the farm plant incurred penalties of 5.85 cents per plastic bag and $10.00 per ton of ice in obtaining small lot deliveries.

Length of Season

Table 23 and Figure 9 bring out the effect of variations in season length on combined fixed and variable processing costs in subscald and semiscald evisceration plants. The critical factor is the weight of fixed costs in relation

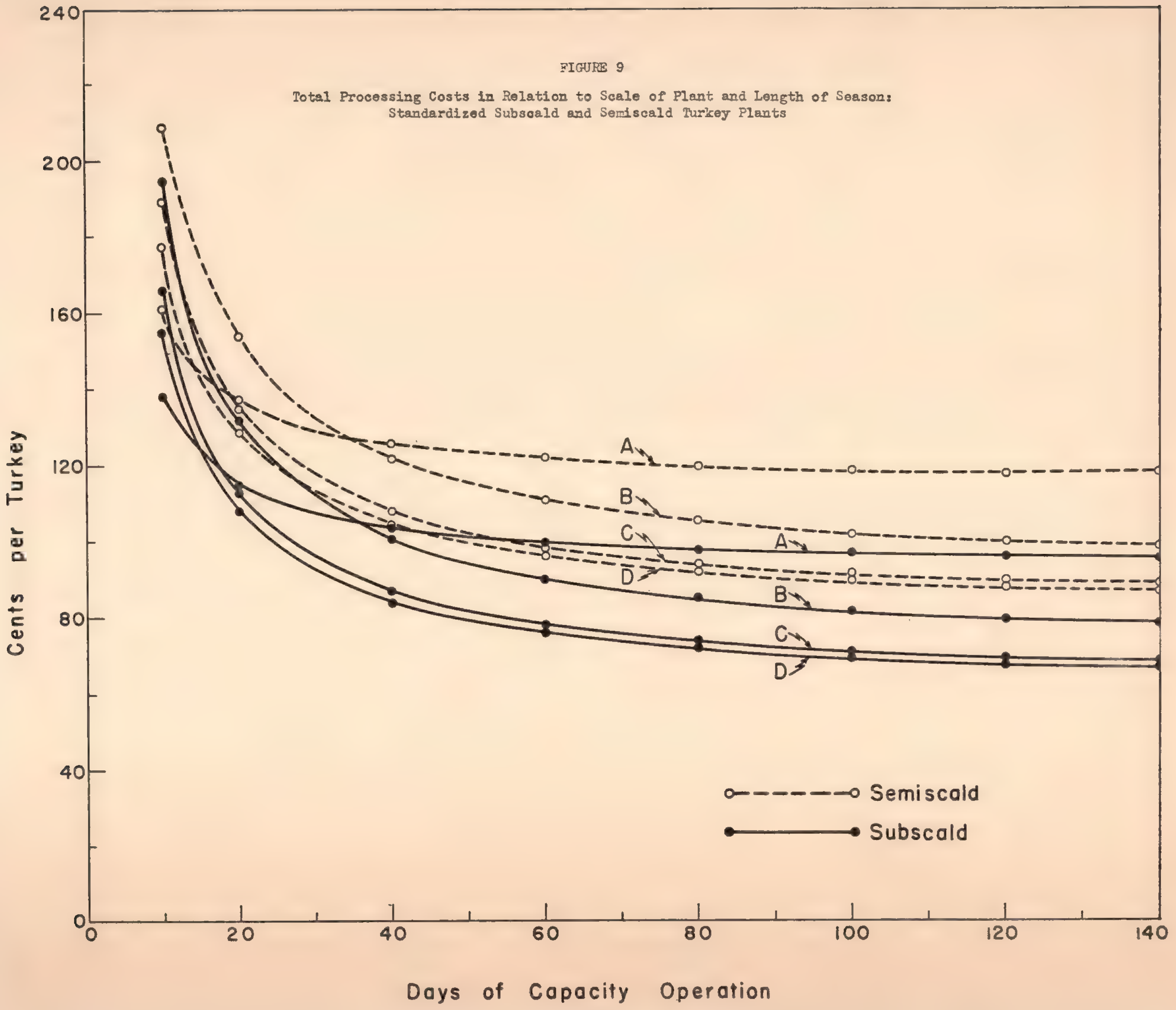

FIGURE 9

Total Processing Costs in Relation to Scale of Plant and Length of Season: Standardized Subscald and Semiscald Turkey Plants

to direct items. The higher the ratio the more advantage is gained by operation over a longer season. Over the segments of the curve where the angle is steep, there is most to gain by expanding annual output. Where the angle is flat, costs show little prospect of diminution even with substantial increases in output. However, since the critical area where most plants operate generally lies outside the steepest part of the curve, small absolute gains may have great importance competitively.

TABLE 23

Total Costs Per Turkey for Subscald and
Semisclad Evisceration Plants

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
	cents per turkey			
Subscald evisceration				
Days of operation				
10	137.78	194.58	165.56	154.76
20	114.70	131.73	112.94	107.26
40	103.16	100.30	86.63	83.51
60	99.31	89.62	77.86	75.59
80	97.39	84.59	73.48	71.64
100	96.24	81.44	70.84	69.26
120	95.46	79.25	69.09	67.68
140	94.92	77.56	67.84	66.54
Semiscald evisceration				
Days of operation				
10	161.02	218.48	189.16	177.55
20	137.30	153.59	134.63	128.54
40	125.43	121.14	107.36	104.04
60	121.48	110.33	98.28	95.87
80	119.50	104.92	93.73	91.79
100	118.32	101.68	91.01	89.34
120	117.52	99.52	89.19	87.70
140	116.96	97.97	87.89	86.24

For all plants, the ratio of variable to fixed costs is lower under the subscald procedures than semiscald. Accordingly, greater benefits ensue from expanded seasonal outputs under subscald methods than under semiscald. Thus, in plant B, for example, extending the season from 40-60 days would reduce its

costs 10.6 per cent with subscald procedures as against 8.9 per cent semiscald procedure. However, this particular differential between the two techniques may not be the most significant.

In general, plant, equipment, and administrative overheads were a strong influence up to the sixtieth day of capacity operation. Extension of the season from 60-100 days would cut the costs of plant A by 3.1 per cent, plant B by 9.1 per cent, those of plant C by 9.1, and plant D by 8.4 per cent. The rate of gain in cost reduction between seasons of 60 and 100 days' duration is small compared with that obtaining up to 60 days.

Plants C and D are the most economical provided they are operated for at least 20 days. However, the gains achieved by duplicating the plant C line as in plant D rarely exceed 2 cents per turkey or 3.5 per cent. Plants operating a single conveyor with an output of about 600 turkeys per hour achieve the major technical economies feasible with the equipment in current use. The larger plant D does not reflect any real intensification in the application of mechanical equipment relative to labor. Such economies as it offers spring from savings in administrative overhead and purchases of material. It also possesses the competitive advantage of flexibility. It can operate both at twice the rate of C during the seasonal peak and at the same rate as C when the peak demand has passed without seriously prejudicing its cost position. Operation of one line only would increase unit costs by the portion of administrative and plant overhead charges appropriate to the other lines standing idle.

Over seasons of shorter duration, plant A is the most efficient as befits a farm plant designed primarily to handle a single flock. Its costs continue to fall fairly steadily up to seasons of 40 days beyond which extension of the period of operation registers little change. With minimal administrative costs and a low investment in machinery relative to the other plants, the fixed costs are low. Since its direct costs are high, there is little scope for cutting total cost per unit by increasing output. Less efficient labor use because of a low level of mechanization is responsible for 50 per cent of its direct cost disadvantage. The remainder is attributable largely to high purchase prices for ice and packaging materials delivered in small lots.

The smaller commercial plant B (capacity of 300 turkeys per hour) cannot approach the efficiency of the more intensive lines at any level of output. It is a victim to pure economies of scale and to the availability of equipment suited to more economical operation at a higher level of output. The nature of the layout is such that some labor stations require the attendance of at least one person. Yet, in that job, one person could easily handle more than 300

birds per hour. The minimum differential in cost between plants B and C is 10 cents per turkey; over an average short season, it would be 12-14 cents.

Supplementary Expenses

In addition to the foregoing, certain other major cost factors bear on the total expenses associated with the processor's phase of turkey marketing. These supplementary expenses have been estimated and set out in Table 24 together with the most realistic estimates of processing costs in cents per pound (live weight and eviscerated weight bases separately).

Trucking Charges.--The movement of turkeys from farm to processing plant is generally arranged by the processor. An appropriate supply of transportation cages was provided in the equipment of each plant. Plants specializing in turkeys hire trucks and drivers in view of the extreme seasonality in their transportation requirements. Trucking costs are affected by the mileage covered, the time spent loading, unloading, and waiting, the number of birds loaded at each point, and the terms on which such work is offered. The detailed implications of these factors were not studied. Average trucking charges incurred by seven plants ranged from 0.5 cents down to 0.3 cents per pound live weight. Firms able to divert to turkey work vehicles maintained primarily for chicken and other uses were able to handle their turkey transportation at substantially lower costs.

Freezing.--Sharply increasing proportions of the turkey crop are now marketed frozen. New York dressed birds can be held in 34° F. cool rooms and transported in iced cars. Evisceration exposes a wide area of internal body tissue to bacterial invasion. Quality may be maintained for periods of 1-2 weeks by packing the fresh wrapped product in ice. Subscalded carcasses may be distributed fresh where the birds are enclosed moist inside a vacuumized moisture-vapor-proof wrapper. Nevertheless, evisceration plants run less risk of product deterioration and attain greater freedom in processing and marketing when they have guaranteed access to freezing facilities. Quick freezing limits the formation of large ice crystals within the cell structure and thus minimizes the mechanical effect exerted on the meat tissue by such crystals.

Most evisceration plants in California are located adjacent to commercial refrigeration warehouses or are developing facilities of their own. Provision was made in equipping and staffing the standardized plants for the transportation of packaged turkeys to an adjacent or near-by freezer. The charges shown in Table 24 are those applicable for quick freezing and one month's storage.

TABLE 24

Total Turkey Processors' Expenses for Subscald Evisceration Plants, 1953

	Plant			
	A	B	C	D
Turkeys per hour	60	300	600	1,200
	cents per pound live weight			
Labor[a]	1.59	1.34	1.23	1.23
Utilities	0.02	0.04	0.03	0.03
Ice	0.61	0.24	0.20	0.20
Packaging materials	1.60	1.25	1.23	1.22
Miscellaneous	0.03	0.06	0.05	0.03
Administration[b]	--	0.34	0.22	0.18
Plant and equipment[b]	0.70	0.61	0.26	0.25
Total	4.55	3.88	3.22	3.14
Trucking	--[c]	0.40	0.40	0.40
Freezing[d]	0.70	0.61	0.61	0.61
Inspection	--	0.06	0.03	0.03
Total	5.25	4.95	4.26	4.18
Shrinkage[e]	4.65	4.65	4.65	4.65
Total	9.90	9.60	8.91	8.83
	cents per pound eviscerated weight			
Labor[a]	1.95	1.63	1.50	1.50
Utilities	0.02	0.05	0.04	0.04
Ice	0.75	0.29	0.24	0.24
Packaging materials	1.96	1.53	1.50	1.49
Miscellaneous	0.04	0.07	0.06	0.04
Administration[b]	--	0.42	0.27	0.22
Plant and equipment[b]	0.86	0.74	0.32	0.30
Total	5.58	4.73	3.93	3.83
Trucking	--[c]	0.49	0.49	0.49
Freezing[d]	0.85	0.75	0.75	0.75
Inspection	--	0.07	0.04	0.04
Total	6.43	6.04	5.21	5.11
Shrinkage[e]	5.68	5.68	5.68	5.68
Total	12.11	11.72	10.89	10.79

[a] Plants A and B, wage rate II; plants C and D, wage rate I.

[b] Based on operating seasons: A, 30 days; B, 60 days; C and D, 100 days.

[c] Birds originate on the premises. Farm vehicles are used. Workers' loading time is covered in processing labor costs.

[d] Quick freeze and one month's storage.

[e] Assuming 15 per cent weight loss; live to eviscerated, and original live weight price, 31 cents per pound.

These freezing charges should be set partly against the labor economies of subscald picking, partly against savings in spoilage and place-time extension of the market.

Since many processors would prefer to control their own freezing facilities, it would be helpful if the cost of constructing and operating freezers of various capacities could be estimated on some uniform basis. However, the number of processors presently equipped with satisfactory freezers is too small for their operations to provide a sound basis for generalization. Moreover, the application of refrigeration principles to food-handling problems is still in a developmental phase. The techniques on which the existing specialized poultry freezers are based may be supplanted by more economical or convenient designs.[1]

Inspection.--Federal inspection of all birds for wholesomeness is not compulsory in California. However, most plants eviscerating turkeys for sale through wholesale channels obtain federal inspection service in their own interest.[2] Produce marked "Inspected for Wholesomeness by the United States Department of Agriculture" is preferred, in distant markets especially, over birds not so marked. The real cost of this inspection service considerably exceeds the actual fees and administrative charges. Structural alterations in the plant, additional labor to carry out work in a sanitary manner, additional operations such as removal of the oil sac, delays while condemned carcasses are removed or trimmed, and condemnation losses of birds that would not otherwise be rejected all contribute to the expense of federal inspection.

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[1] Types employed in the plants studied included blast freezing tunnels and individual freezer plates. New approaches envisage the conveyance of individual birds through the freezing area on a moving belt and the quick freezing of packages as stacked by fork-lift truck in standard holding rooms by means of localized low temperature jets. See E. Simons, "Jet Freezing," Food Engineering, November, 1953, p. 57. The designs compared by Simons show a ratio of horsepower required to tonnage of poultry frozen of 0.94 for the jet duct as against 2.35 for the high velocity tunnel. On page 139, Simon says "There is doubtful economy in employing a heavy air blast when heat transfer from the product is controlled by the rate of surrender in the product in oozing heat transfer to an air movement, which is properly maintained above a lower critical minimum velocity."

[2] As of October, 1953, 13 plants handling over 50 per cent of the California turkey crop eviscerated under the U. S. Production and Marketing Administration Inspection Program.

Since the standardized plants were set up, equipped, and staffed to conform with U. S. Department of Agriculture inspection requirements, it is assumed that plants B, C, and D obtain this service. The fees are based on the hours worked by the inspector (hourly rate assumed as $3.00) plus an administrative service charge of 12 per cent. Clearly, the low volume and intermittent schedule of the farm plant would not warrant the employment of an outside inspector. Costwise, the hourly charge also bears more heavily on B than C in reflection of its lower output.

Processing Weight Loss.--Loss in weight as a result of processing is a different type of cost from those heretofore considered. It does not reflect the price of an input service rendered by the processor but constitutes a weight difference allowance between the price paid by the processor and the price charged to the next buyer. Except where birds are purchased on a dressed-weight basis or are custom dressed, the weight loss ostensibly falls on the processor. New York dressed birds are lighter by the loss of blood and feathers; eviscerated produce, by the additional loss of inedible entrails, head, and feet. The rate of shrinkage reflects a combination of influences, the duration and circumstances of the waiting period before slaughter, the age, weight, sex, and strain of the birds, the season of the year, the parts of the carcass removed, and the method of chilling employed. Processors' over-all yield rates may also reflect losses from condemnation of defective carcasses or parts of birds damaged en route to the plant.

Shrinkage losses reported by the participating processors ranged from approximately 15-23 per cent live to eviscerated weights. However, the group of plants claiming that their standard loss on evisceration was 22-23 per cent did not employ the subscald technique. All their birds were semiscalded and New York dressed. Evisceration was regarded as a separate process. Under such circumstances, less attention is paid to ice chilling and the quick freeze.

Apart from differences of procedure in replacing "edible giblets" after evisceration, the critical factors in the existence of such a wide range in shrinkage rates relate to the amount of undigested feed in turkeys' crops at the initial weighing and the method of chilling. A full crop may contribute as much as one pound to the apparent live weight of an adult turkey. Since all this weight is lost in the course of evisceration, birds which had been starved before the first weighing would show correspondingly high evisceration yields.

Cooling by exposure of the eviscerated carcass in a dry-air refrigeration room results in weight losses by dehydration. Immersion in ice slush avoids such losses and is associated with actual weight gains. Of this latter gain, part may reflect absorption of water into the out skin and muscle and part may reflect merely the retention of water in crevices and folds about the carcass. Limited draining, enclosure in a moisture-vapor-proof wrapper, and quick freezing immediately following water chilling may consolidate such weight gains. Laboratory controlled tests on 1,000 turkeys showed weight gains between hot evisceration and enclosure in the wrap after ice-slush chilling of 0.9-7.0 per cent.[1] Factors affecting this variation include the temperature of the ice slush, the duration of the immersion, and the degree of surface exposure. Agitation of the ice slush and the maintenance of low temperatures enhanced the rate of absorption. The temperature of the scald is not regarded as a significant factor in shrinkage.[2]

If plants pursuing one technique may obtain processing yields of 85 per cent while others obtain only 78 per cent, the differential is of prime competitive significance. Table 25 indicates the cost effect at different price levels.

TABLE 25

The Cost of Evisceration Weight Losses in Processing Turkeys in Relation to Price

Live weight price	Per cent weight loss live to eviscerated						Differential 15-22 per cent loss
	14	15	16	21	22	23	
	cents per pound, live weight						
30	4.20	4.50	4.80	6.30	6.60	6.90	2.10
31	4.34	4.65	4.96	6.51	6.82	7.13	2.17
32	4.48	4.80	5.12	6.72	7.04	7.36	2.24
33	4.62	4.95	5.28	6.93	7.26	7.59	2.31
34	4.76	5.10	5.44	7.14	7.48	7.82	2.38
35	4.90	5.25	5.60	7.35	7.70	8.05	2.45

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[1] Unpublished research data by G. F. Stewart, University of California, Davis. For details of experiments with chickens showing comparable results, see R. L. Bailey, G. F. Stewart, and B. Lowe, "Ice Slush Cooling of Dressed Poultry," Refrigeration Engineering, April, 1948, p. 369.

[2] Personal observation by H. Lineweaver, U. S. Department of Agriculture, Western Regional Research Laboratories, Albany.

At an average purchase price of 31 cents per pound live weight, an eviscerating loss of 22 per cent costs 6.82 cents per pound--a loss of 15 per cent or 4.65 cents. On the 22-pound turkey, the total weight losses amount to $1.50 and $1.02, respectively. It is immediately evident that the difference between the two levels of yields, some 48 cents per turkey, constitutes a major factor in the economics of processing. The spread between the two ranges of yield is almost as large as the total cost of processing. Restriction of weight loss to the lower end of the range in some plants and not in others would give the former a competitive advantage which no degree of technical and administrative efficiency could counterbalance. Weight loss costs corresponding to the minimum rate have been applied to all plants uniformly in Table 24.

Inclusion of these supplementary expenses raises the total cost to the processor of transferring live birds at the ranch to eviscerated produce in frozen storage to a minimum of 8.83 cents per pound live weight. The expenses of the smaller commercial plants and farm processors approximate to 10 cents per pound. The second half of Table 24 presents the same data in terms of eviscerated weights.

Subscald Processing and the California Industry

Hitherto the implications of new techniques in processing have been analyzed within a framework of standardized plants set up according to certain theoretical specifications. The function of this chapter is to examine the processing industry in California with a view to assessing the benefits forthcoming from the adoption of subscald techniques within the present structure.

The potential results from adaptation to a changed technical environment may be considered from two points of view. Individual processors will be affected by new emphases in the character of the competition faced on their own home ground. The industry as a whole is concerned as to the broad implications for the competitive position of California turkeys in outside markets.

Location of Plants.--The turkey processing industry in California is characterized by large specialized plants located in the main producing areas. Most of the birds raised in the outlying counties are drawn in to the center of the greater concentrations for processing. The major plants are located in the San Joaquin Valley cities of Modesto, Turlock, and Fresno and on the periphery of the Los Angeles urban area. None of the few scattered commercial plants serving producers outside these main concentrations obtain more than 1½ per cent of the total business.

Figure 10 shows the approximate locational relation of processing plants to commercial turkey production.1/ The advantages of close proximity to a substantial supply of birds include reduced trucking expenses, better timing of operations, and the possibility of expanding the output of the plant without incurring heavy additional transportation costs. The place of the country buyer or huckster as an intermediary assembly agent disappeared as individual growers' flocks became large enough to warrant the full attention of the processor. Problems in feeding turkeys transplanted out of their accustomed environment, and consequent weight losses have made direct transfer from farm to killing point the customary practice.

Although turkeys are raised in most of the agricultural counties, the degree of local concentration in California is high compared with most other parts of the country. Flocks of 20,000 turkeys are not unusual in the San Joaquin Valley area. Sixty per cent of the crop is raised in the counties from Stanislaus to Tulare and

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1/ Based on the 1949 United States Census of Agriculture revised according to County Commissioners' Annual Reports to represent an average of the 1952 and 1953 seasons.

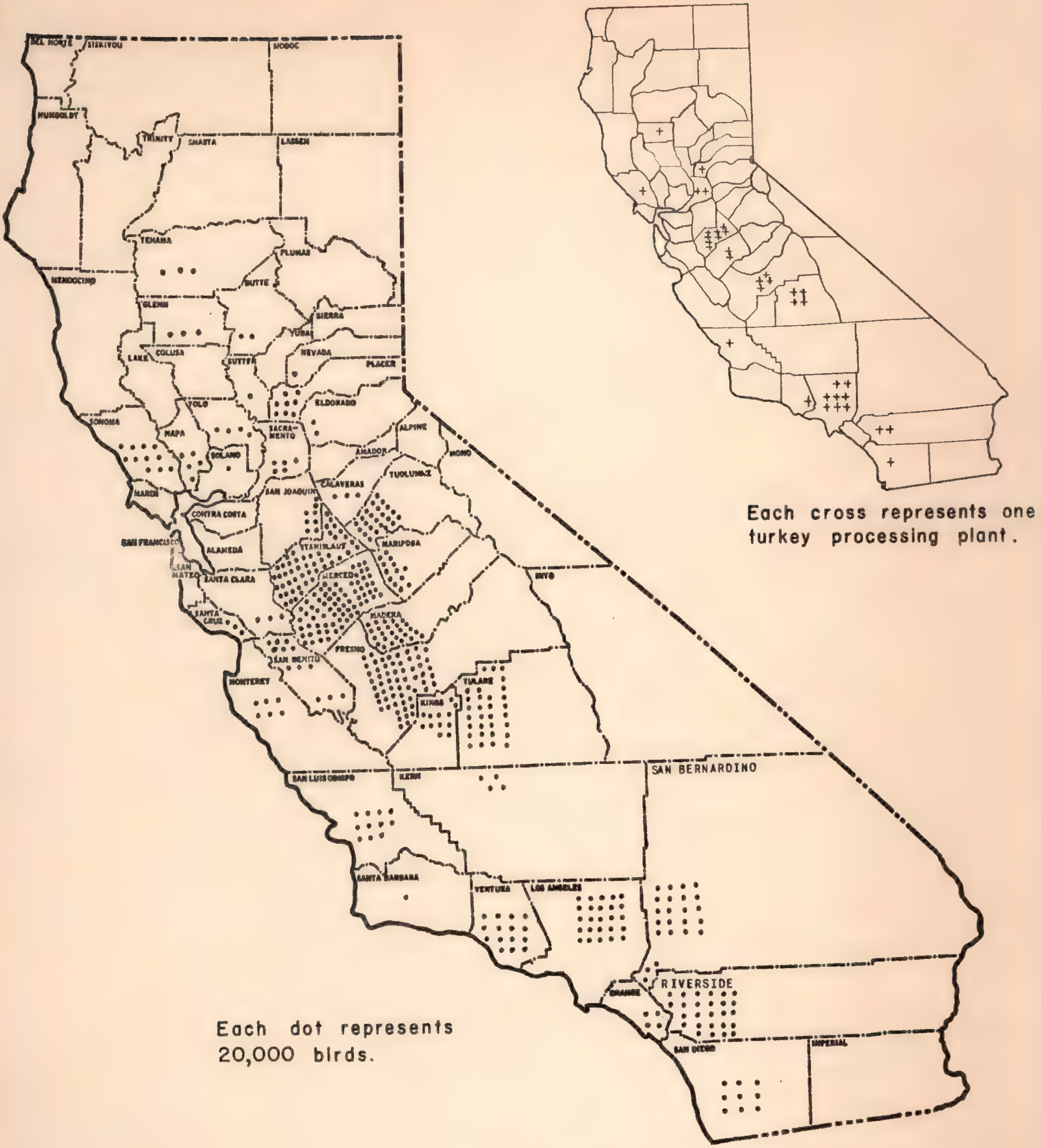

FIGURE 10

Location of Turkey Processing Plants in Relation to Production:
California, 1952-53

the bordering foothills.[1] A secondary concentration in the periphery of Los Angeles extends from Ventura to San Diego counties.

Location factors involved in the success of turkey enterprises, besides the climate, include inexpensive land, good transportation facilities, and a favorable institutional and economic environment for the provision of ancillary services. A significant element in the expansion of the industry in its present location has been the generous extension of credit by competing feed companies. Once established, industry concentration brings external economies in the operation of hatchery, feed, equipment, veterinary, and marketing services and, subject to the risk of epidemic disease, cumulative over-all efficiency.

Killing and dressing the flock on the grower's farm was years ago the first step in the marketing sequence in many areas. Under the pressure of seasonal overloads, arrangements for centralized killing could not be provided for outlying producers. Wholesalers picked up the dressed birds for redistribution in the cities. Now the manufacture of equipment specifically designed for small units has enabled many growers to prepare oven-ready birds for retail consumers under economical and sanitary conditions. Farm plants are generally set up to process flocks of 5,000-20,000 birds.

These farm-processing enterprises appear to be strongest in southern California. There intermittent urbanization combines proximity to city consumers with the necessary space to carry the growing birds. Farm processors also find a place in areas of scattered production that do not support a specialized enterprise. Growers undertaking processing work expect to obtain retail prices for most of their flock. If many birds remain unsold after the peak markets and have to be stored under refrigeration or wholesaled to regular distributors, the higher costs of processing would make competition with commercial operators impracticable.

Size of Operation.--Analysis of individual plant outputs is dependent on trade estimates. Information furnished to authorized market reporting agencies may not be made public in such a form as to reveal any one firm's business. However, it is safe to say that the annual output of one or two firms (approximating to plant type D) may approach 1,000,000 turkeys. A further four or five

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[1] The predominance of the San Joaquin Valley counties is relatively recent. A similar map prepared on a basis of the 1930 United States Census of Agriculture indicated that the main turkey center formerly lay in the Glenn and Tehama counties of the Upper Sacramento Valley. See J. M. Tinley and E. C. Voorhies, Economic Problems Affecting Turkey Marketing in California (Berkeley: 1937), p. 21. (California Agricultural Experiment Station Bul. 612.)

plants probably handle over 500,000 each, and another ten, 250,000 or more. The economies of plant C are potentially available to all this group. Thus, 70 per cent of the California turkey crop could be processed at or below the cost level appropriate to plant C. A further dozen concerns achieve annual outputs exceeding 50,000 head each. These latter fall into size category B and would tend to incur its competitive disadvantages. The cost evidence suggests that these smaller commercial units will find maintenance of their share of the trade increasingly difficult. Ultimately, consolidation into larger units or retirement from the business may be forced upon them. This conclusion is supported by the fact that several of the smaller commercial concerns changed hands during the course of the study. At the same time, new plants are being equipped to enter a sharply competitive business.

The question then arises will there be enough business to maintain processors setting up plants on such a scale as to obtain the major economies. The investment in fixed plant and equipment can be paid off only over a period of years. Therefore, processors must have reasonable expectations of five to ten years' operation at an economic level for the plant.

Fluctuations in Production.--The short reproduction cycle of the turkey permits considerable flexibility in production plans. Since California growers maintain large flocks on a specialized and economically sensitive base, the possibility of exaggerated production-price fluctuations is almost as serious as in the chicken fryer industry. However, under pressure from government advisers and its own organizations, the industry has shown some response to professional forecasts of future prospects. Great attention has been given to methods of influencing growers' decisions through the season with a view to matching supply and demand at a stable price level. Successive early indicators of the production and price outlook include reports of breeder hens tested for pullorum disease by official state agencies, of farmers' production intentions on January 1, of cold storage holdings of the previous season's crop, and of the poults hatched and eggs under incubation in the spring. Rational attention to these warnings by the bulk of the industry would facilitate correction of extreme production swings during the course of the season. The maintenance of a relatively stable over-all output would make for the most efficient use of resources in all phases of the industry.

Season Length.--It became apparent from Figure 8 that extension of the turkey processing season to 60 or 80 days of capacity operation would bring significant economies in the larger plants. How far is it possible for processors to meet these requirements under contemporary conditions in California?

Extreme seasonality in marketing has been characteristic of the turkey industry. Traditionally, turkeys have been prepared for the Thanksgiving and Christmas markets with a relatively small number of breeding birds coming forward for slaughter in early summer when their reproductive purpose was served. Since the bulk of the crop was marketed fresh, the processing season was short and intensive. Practically the whole year's output was handled in two periods of a few weeks' duration. Two factors have played a part in extending the season significantly. Wider acceptance of frozen poultry has enabled the retail trade to prepare for the same peak markets over a much longer period. In 1953 the main chain store buyers completed purchases for Thanksgiving well in advance of the holiday week. Development of broader markets for turkeys at other times of the year has likewise made a contribution.

Figure 11 depicts the seasonal distribution faced by the processing industry in California in 1953. It is based on the weekly output of 17 commercial plants in the San Joaquin Valley.[1] Together they handled two thirds of the total crop and may be regarded as fully representative of the most commercial segment of the industry. Forty per cent of the crop was processed during the months of November and December as against much higher proportions in previous years and a contemporary average for the United States of 55 per cent.[2] The effective season now begins in August. Eighty per cent of the crop is handled over five months through December. Thus, it is quite feasible that a substantial number of plants would be able to operate 80-100 days a year. On the basis of the 1953 season, additional work was available from mid-October to the third week in December. This shorter season of some 40 days would involve the opening of additional higher cost plants or overtime work in those operating over the longer season.

Figure 11 further indicates that the processing of light-breed turkeys offers little scope for counterbalancing the seasonal bunching of heavy birds. Marketings proceed at a steady pace through the year and adapt best to continuous handling by a small number of plants set up specifically for this work.

Close dovetailing of turkey and chicken processing is rare in California. Only one or two of the plants studied operated on such a basis. Considerable adaptation is required, and efficiency is reduced when the same equipment is employed for adult heavy-breed turkeys and the much smaller chicken. However, some

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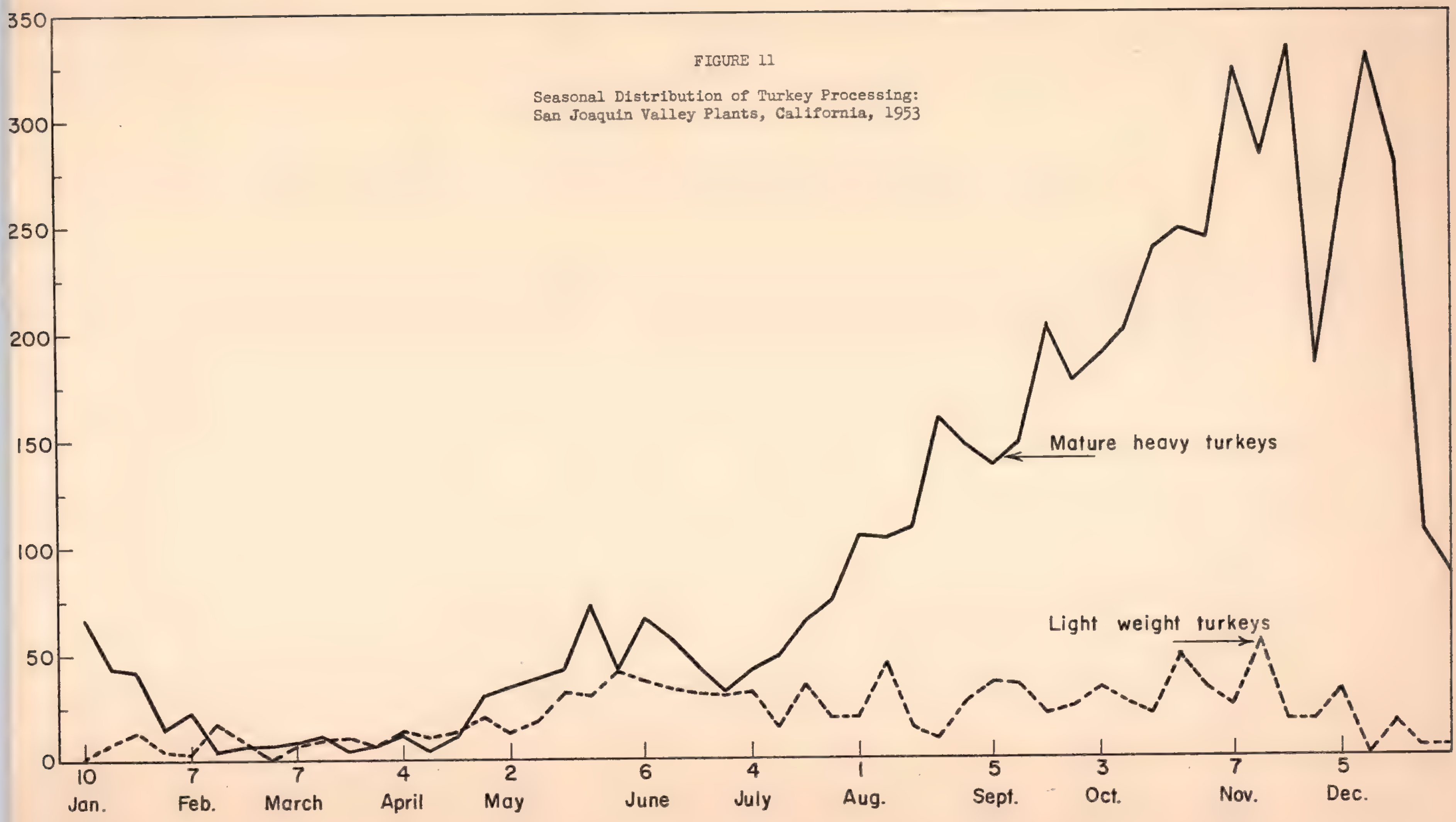
[1] By courtesy of R. M. Lockhart, Federal-State Market News Service, Fresno.

[2] U. S. Bureau of Agricultural Economics, The Poultry and Egg Situation (Washington: Govt. Print. Off., September-October, 1953), p. 28.

FIGURE 11

Seasonal Distribution of Turkey Processing:
San Joaquin Valley Plants, California, 1953



of the largest and most strongly established concerns handle both turkeys and chickens in the same plant by maintaining separate conveyor lines for each. Administrative and some plant overheads may be spread over a larger turnover in this way if not the cost of processing equipment. Labor resources may be switched between chicken and turkey lines according to demand. The prospect of regular employment attracts a better class of help on more favorable terms.[1/]

Structure of Enterprise.--The nature of the competition both within the industry in California and between California plants and others is colored by the structure of enterprise. The postwar expansion in turkey production attracted and received additional impetus from the intervention of the big meat packers. Approximately one third of the turkey crop is now processed in plants controlled by national concerns with headquarters located outside California. Operation in all parts of the country permits the use of influential national advertising and publicity media at low unit cost. Integrated distributive organizations enable them to carry their own specific product, supported by a strong list of complementary food lines, right into the retail store. Individual packaging of turkeys in color-printed wraps will further this trend since every bird displays and publicizes the name of the processor. Firms that do not take advantage of this opportunity to establish a brand name in the public eye inevitably will find satisfactory marketing increasingly difficult.

The specialized commercial processing plants in local independent ownership number some 15 and handle almost half of the total turkey production output. The leading concerns have grown up with the turkey industry in California and matched the pace of technical change. However, the traditional marketing practice of consigning unbranded produce to commission agents in distant markets is proving inadequate. It affords no opportunity to build up specific public good will or to control the price and sales policies of agents who may also be commissioned to move other turkeys in direct competition. In response to competitive pressure, the strongest independents have developed permanent links with sales representatives in San Francisco, Los Angeles, and other cities. Most now employ a brand name. The wholesaling agency is either a department of the same firm or an exclusive representative. Other plants located at country points have been taken

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[1/] Lower wage rates in turkey processing plants in Virginia were attributed in part to the regularity of the employment offered. The small turkey, which predominates in that region, is handled in conjunction with chickens. Most plants run for 52 weeks in the year. Information supplied by Rockingham Poultry Marketing Cooperative, Broadway, Virginia.

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1/ Lower wage rates in turkey processing plants in Virginia that are located [illegible] predominates in that region, is handled in conjunction with chickens. [illegible] over by, or operate in partnership with, distributive houses based in the terminal market cities and are thus assured of a direct outlet.

The part played in the turkey market by independent distributors, carlot shippers, and brokers is declining as firms bridge the gap between processing and distribution by combining both functions under the same ownership. Two such intermediary firms specializing in turkeys base their operations in San Francisco, and a few more are established in Los Angeles. Their business depends on a specialized knowledge of price and demand trends throughout the country and the ability to locate the specific categories of product sought by particular clients.1/ Independent arbitrage of this type depends on good contacts at procurement and disposal points, access to credit, and transportation on immediate demand.

Apart from outright sales to processors, growers have the opportunity of dispatching their birds to nine or ten cooperatively owned plants. Two major marketing organizations, with which most of the plants are affiliated, undertake to move their output in the main California and eastern consumption centers. Together the cooperative groups handle about 10 per cent of the total crop, less than half of the share they held before the war. A critical issue in this section of the industry is the conflict between demands for plants located to suit the convenience of comparatively isolated grower members and access to the economies of large-scale operation in a few central positions. All but one of the plants open in 1953 fell into scale category B or smaller and sustained the handicaps associated therewith. New plants and proposed modifications are bringing the cooperatively owned facilities into line with modern techniques. They will not necessarily solve the problems of low individual turnover and high overheads.

Most turkey cooperatives offer the alternatives of combination with other members in a pool-pricing system or individual grower control. Under the pool plan, all lots are fused on a grade and size basis and sold at the discretion of the management. Growers participate in the final returns according to the average price obtained for the different grades. The second procedure permits members to preserve the identity of their own flock during processing and offer it

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1/ A broker bringing buyer and seller together charges a commission (1/2 cent per pound, carlot basis, 1 cent per pound less than carlot). A typical deduction to maintain an exclusive agency or department assuming full marketing responsibility would be 1½ cents per pound.

for sale at a time of their own choosing. Both cooperative and other plants that process birds on a "grower contract" or a custom basis incur additional labor and storage costs keeping grower lots separate. Full confidence in the grading skill and integrity of the plant staff would eliminate most of these additional expenses.[1] Approximately the same results can be obtained by close accounting for respective grades and quantities and commensurate sales at the instructions of the grower.

Adaptation to Subscalding.--The pace of adaptation to subscald procedures is limited by two main factors: inability of existing plant structures to meet evisceration sanitary requirements and the feeling in some sections of the trade that part of the market still prefers semiscalded produce.

Many of the older turkey dressing plants were constructed of wood or metal sheeting, with open rafters and limited draining facilities. The expenditure necessary to install sanitary inner walls, ceilings, and the necessary service fittings frequently exceeds the value of the plant. Most were built with a 34° F. cooling room in the middle of the New York dressing process. This structure is generally an obstacle to the efficient organization of the ice-chilling arrangements which replace it. The increment in cooling gained by wheeling in the loaded tanks hardly compensates for the handicaps of cumbersome layout. A few occupy sites which preclude any possibility of adding evisceration or cooling space. Other plants reflect a patchwork addition and adaptation of buildings originally constructed for other purposes. Nevertheless, it is feasible for processors to subscald and eviscerate in premises that do not meet inspection standards in their entirety provided that local sanitary authorities are satisfied and no defect is found in the product at the market. Certainly such a course is preferable to accumulating a heavy overhead burden in small plants lacking the output to support it.

The chief advantage of semiscald dressing lies in maintaining the protection against deterioration afforded by the turkey's original outer skin. Marketing procedures are simpler. Fresh sales may be conducted under less stringent conditions, and freezing, where necessary, may be carried through at a slower rate without discoloration in the product. Some markets are still suspicious of the subscalded bird and are reluctant to purchase from plants using such techniques. Plants maintaining semiscald picking procedures may also process birds New York style when it appears desirable. During the peak holiday market, this position

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1/ Estimated informally by two plant managers as 10-20 per cent of the total direct labor cost.

may enable them to take on additional business with the same equipment. Some operators wish to retain a foothold in both markets.

Attachment to New York dressing procedures stems from the long supremacy of distribution in this form and the continued demand for fresh dressed birds among certain consumer groups. San Francisco is a major stronghold. In New York dressed birds, the body cavity remains intact up to the point of sale to the consumer, so the opportunity for internal drying out and discoloration is limited.

In merchandising, the more attractive appearance and greater convenience of the packaged eviscerated product are countered by the lower quoted price per pound of the New York dressed bird. Inedible elements included in the latter's sales weight are subsequently removed.

Trade interests with a substantial New York dressed bird clientele encourage this preference as a measure of market protection. Conversion to evisceration and individual packaging might expose them to full competition with nationally advertised brands and mass selling in the chain stores.

The distribution of New York dressed poultry is, nevertheless, rapidly disappearing from the marketing scene. It labors under several serious disadvantages in the present technical and marketing environment. New York dressed birds with head and feet attached do not attract the modern housewife. Effective display is more difficult. They now appear most frequently on the premises of small wholesaler-retailers, often carry no convincing evidence of grade or origin, and tend to be associated with a lower quality atmosphere. Finally, individual evisceration must be carried out at some stage at a greater labor cost than in a mechanized plant.

The labor costs involved in dressing birds at a specialized pland and eviscerating them at the retail store may be compared with those of dressing and eviscerating in the same plant. Table 25 shows the estimated disposition and cost of labor in plants A, B, C, and D were they to operate on a New York dressed basis. The necessary data were obtained from actual plants under the same conditions as those specified in conjunction with the evisceration models. Construction of the four models followed the same procedure. The labor cost in New York dressing, the major item by far, does not vary greatly with the size of plant. A powerful standardizing influence is the pickers' piece rate. Since plants of A and B size generally obtained the labor at the lower wage rate, the effective labor costs of all sizes of plants were much the same.

Estimates of the time required to eviscerate adult Broad Breasted Bronze turkeys in retail stores were obtained by a limited inquiry which covered two major grocery chains, a store specializing in poultry parts, and some independent meat markets. The estimates ranged from two to five minutes between stores. Some of the variability was associated with the amount of time given to conversation with the customer during the process. The estimate of two minutes related to behind-the-scenes evisceration in a large chain which set up this figure as a production goal. A direct competitor specified two to four minutes for fresh turkeys and three to five minutes for birds which had been frozen.

It would appear that, whereas retail butchers might be able to eviscerate turkeys in two minutes on a production line basis, three to four minutes would be a reasonable estimate for the whole retail trade. Such an estimate would include some allowance for time elapsing between customers and for cleaning chores. Packaged eviscerated produce is generally offered on a self-service basis.

In Table 26 over-all labor costs are presented for subscald plant dressing and evisceration and New York dressing with evisceration on the retail counter. The retail butcher's time was valued at $2.00 per hour plus 6-per cent employer contributions. Allowance is made for a range of time periods spent on each turkey. In each case, birds are drawn from comparable plants. Retailers eviscerating in two minutes can compete with farm eviscerating plants; otherwise, their disadvantage in labor cost is clearly evident. The differential between New York dressing in a large plant plus three minutes evisceration time in the store and subscald dressing and evisceration in the same plant is over 13.0 cents per turkey.

In this context it may be noted that the cost of packaging subscalded eviscerated birds would exceed that of New York dressed birds by 8-9 cents per turkey. Quick freezing and one month's refrigerated storage of the subscalded product would cost a further 13.5 cents per turkey at custom rates. New York dressed turkeys are normally sold fresh.

Subscald Impact on Competition with Other Areas.--The presence of large supplies of migrant labor has not, apparently, enabled California turkey processors to hire workers on favorable terms. In the main centers, they compete with high returns from piecework in specialized fruit and vegetable harvesting employment and must negotiate with an active labor union.

Normal processing labor wage rates in plants situated in Nebraska, Minnesota, and Virginia averaged 30 per cent lower than the union scale observed by the major California plants. Table 27 indicates the impact of such a wage

TABLE 26

Comparison of Labor Costs for Dressing and Evisceration in Subscald Plants and New York Dressing with Retailer Evisceration

Plants	Turkeys per hour	Wage scale	Total labor cost				
			Dressing and evisceration in subscald plants	New York dressed with retailer evisceration			
				Time required for retailer evisceration in minutes			
				2	3	4	5
			cents per turkey				
A	60	I	41.77	39.13	42.66	46.19	49.73
A	60	II	35.03	35.81	39.34	42.87	46.41
B	300	I	33.56	39.13	42.66	46.19	49.73
B	300	II	29.38	35.75	39.28	42.81	46.35
C	600	I	27.01	36.23	39.76	43.29	46.83
D	1,200	I	27.01	36.20	39.73	43.26	46.80

TABLE 27

Comparison of Poultry Processing Wage Rates California and Major Competing Areas[a]

Plant	Labor costs in processing turkeys		
	California	Competing states	Differential
	cents per turkey		
Subscald evisceration			
B (I)	33.56	23.49	10.07
B (II)	29.38	23.49	5.99
C and D	27.01	18.91	8.00
Semiscald evisceration			
B (I)	53.38	37.37	6.01
B (II)	46.98	37.37	9.61
C and D	46.77	32.74	14.03
New York dressing			
B (I)	32.06	22.44	9.62
B (II)	28.68	22.44	6.24
C and D	28.86	20.20	8.66

[a] Minnesota, Virginia, and Nebraska

differential on the total cost of processing under different conditions. The differential in rates applies proportionately to all workers and between comparable plants.[1]

In Table 27 it is assumed that processors in the competing states obtain the same labor output ratios as comparable plants in California. At the lower agricultural rate, wage costs in smaller plants would be 6 cents higher per turkey than in the competing states. More typical in the context of competition in eastern markets would be the subscald differential of 8 cents between plants of type C and D, almost equivalent to 0.5 cent per pound on the eviscerated weight. However, comparison with the competitive situation when both areas use the semiscald approach shows a reduction in the effective disadvantage of 6.03 cents per turkey, or 43.0 per cent. The ability of California plants to compete with others paying lower wage rates will be enhanced by a changeover to subscald evisceration.

It would appear that the differential is less for the New York dressed birds but increases sharply in the shipment of semiscald eviscerated produce. Subscald techniques reduce it to much the same level as obtains for New York dressed birds.

Freight charge burdens will be affected by the shipment of eviscerated rather than New York dressed produce. If the differences in rail and icing charges to the East Coast cities from California and from the Omaha-Minnesota area is 1.72 cents per pound,[2] the saving in shipping eviscerated produce may amount to 4.0 cents per bird less the cost of additional icing.

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[1] Compare, for example, agreement between Rockingham Poultry Marketing Cooperative, Inc., and Amalgamated Meat Cutters and Butcher Workmen of North America, A.F. of L. Local 393, Washington, D. C.

[2] Fischer, C. M., Studies in Turkey Marketing in the Western States (Logan: 1952), p. 12. (Utah Agricultural Experiment Station Special Report 6)

Summary

1. The outstanding feature of the technical trend in poultry processing is the close interrelationship between merchandising advantage and cost economy. The labor costs involved in dressing and evisceration may be cut substantially by scalding turkeys at water temperatures of 138°-140° F. and carrying them to the ready-to-cook stage in the same plant. However, the cost of packaging and freezing the eviscerated carcasses is sharply in excess of that customary in the New York dressed trade. These additional outlays cancel out the saving in labor but enable the processor to broaden the market for the product and conform to contemporary merchandising trends.
2. In terms of 1953 values, the cost of processing may be reduced 20 cents per turkey or approximately 1 cent per pound by the use of subscald instead of semiscald water temperatures. At the same time, closer attention must be given to the timing of operations up to and including quick freezing if the subscalded birds are to maintain quality and color.
3. Plants handling 600 or more turkeys per hour may reduce their processing costs 22 per cent by adopting subscalding techniques. The estimated saving in a commercial plant rated at 300 turkeys per hour is 19 per cent and in a farm processing plan, 17 per cent. The advantage of small plants in obtaining workers at lower wage rates declines in significance with the labor economies of the subscald system. On the basis of current techniques and costs, the industry will tend to concentrate in the hands of enterprises employing processing lines with a capacity of some 600 turkeys per hour. Smaller commercial plants handling some 300 birds per hour fail to obtain the full potential advantages of specialization from the division of labor associated with the conveyor system. Farm processors benefit from lower wage rates. Nevertheless, their processing costs are estimated at approximately 7 cents per turkey above those of small commercial plants and over 20 cents per turkey above those of the larger processors. Most grower-processors expect to compensate for this disadvantage by selling their birds at retail prices.
4. Operating seasons of 25 capacity days for the farm plant and 80 days for the commercial plants are necessary if their operators are to obtain the major economies of spreading their fixed costs over an increasing output. Low total fixed costs make the farm plant the most efficient over a very short season. For all plants the rate of decrease in combined fixed and variable

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Smaller commercial plants handling some 300 birds per hour fail to obtain

20 cents per turkey above those of the larger processors. Most grower-

at retail prices.

costs slackens between 60 and 80 days of capacity running. The advantages of extending the season beyond 80 capacity working days are relatively small but may still be significant in a sharply competitive environment.

5. Evisceration on the production line at the processing plant is more efficient than treating dressing and evisceration as separate operations and leaving the latter to retail butchers. Estimation of the labor costs incurred in comparable plants revealed that those of New York dressing and retailer evisceration exceed those of the single plant operation by 9-13 cents per turkey depending on the amount of time contributed by the retail butcher.
6. Packaging materials and ice are major cost items when evisceration is carried out at the processing plant. Purchases of these supplies amount to over 50 per cent of total direct costs in eviscerating plants.
7. Weight losses in processing have been reduced substantially with the change-over from dry-air cooling to ice-slush chilling and packaging in a moisture-vapor-proof container. Dressing and evisceration weight losses range from 23 down to 15 per cent of the original live weight. This differential between cooling methods would amount to 48 cents per turkey at average 1953 prices and is comparable to a high proportion of total processing costs.

The over-all conclusion is that the adoption of subscald procedures will bring about a general reduction in processing expenses. Under competitive conditions, processors' margins will contract. The market position of the California turkey industry will be improved accordingly.

Limited opportunity to translate the time saved into profitable alternative occupations may make the adoption of new methods less attractive to small processors and retail butchers. However, on a basis of comparable opportunity costs and internal efficiency, plants adhering to the older practices will face serious competitive handicaps.

APPENDIX TABLE I

Processing Plant Construction Costs for Itemized Estimating Procedure

	Dollars per square foot of floor space
Walls and roof of aluminum sheeting on a steel frame set on a concrete base at truck bed height with drains	3.50
Office and washroom partitions and fittings	3.00
Ceiling	1.00
Plumbing	1.00
Electrical wiring and fittings	1.00
Raised concrete base with drains	1.50
Roof, asphalt built up on wooden frame	0.80
	Dollars per square foot of wall area
Walls:	
Concrete or brick with steel frame	1.75
Glazed brick	1.50
Inside, concrete with smooth finish	1.00
Inside, plaster on wooden frame	0.75

APPENDIX TABLE II

Administrative Salary Estimates for Turkey Processing Plants

Plant	Turkeys per hour	Subscald and semiscald evisceration		
		Management	Office	Total annual salary charges
				dollars
A	60			
B	300	Manager Foreman	1 girl[a]	9,500
C	600	Manager Supervisor Foreman	1 man 1 girl[a]	20,000
D	1,200	Manager Supervisor 2 foremen	1 man 1 girl 1 girl[a]	33,500

a/ Employed for six months.

APPENDIX TABLE III

Wage Rates in Turkey Processing Plants for California, 1953

Type of worker	Rate I (unionized plants)	Rate II (agricultural areas)
	dollars per hour	
Time workers		
Men:		
Killer	2.00	1.75
Hanger	1.47	1.25
Picker operator	1.75	1.75
Grader	1.87	1.50
Other:		
Semiskilled	1.47	1.35
Unskilled		1.25
Night cleaner	1.50	1.35
Motor truck driver	2.00	--
Power fork-lift truck driver	1.75	--
Foreman	1.67	1.50
Women:		
Picker (subscald)	1.37	1.10
Pinner	1.37	1.10
Other:		
Semiskilled	1.47	1.35
Unskilled	1.30	1.00
Night cleaner	1.37	1.35
Forewoman	1.67	1.50
	cents per turkey	
Piece workers		
Killer	1.00	--
Hanger	0.75	--
Picker (semiscald)	17.50	15.50

APPENDIX TABLE VI

Estimated Operating Costs of Ice-Making Units

	Plant A	Plant B
Turkeys per hour	60	300
Turkeys per day	420	2,100
Pounds of ice required per day	7,500	3,800
Ton capacity of unit	3-4	16-20
	dollars	
Estimated investment[a]	7,350	20,000
Annual overhead charge[b]	1,290	3,520
	cents	
Power and water cost per 100 pounds of ice	5.0	5.0
Total cost per 100 pounds of ice:		
Days of operation		
10	180.0	98.1
20	92.5	51.6
40	48.8	28.3
60	34.2	20.3
80	26.9	16.7
100	22.5	14.3
120	19.6	12.8
140	17.5	11.7

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a/ Manufacturer's price augmented to cover freight, sales tax, installation, and refrigerated storage costs.

b/ Depreciation, 10.0 per cent; interest, 3.0 per cent; repairs and maintenance, 3.0 per cent; taxes, 1.0 per cent; and insurance, 0.6 per cent.

c/ Manufacturer's estimate.